PACE OF OIL SHALE DEVELOPMENT

HEARINGS

BEFORE THE

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[Ninety-Sixth Congress]

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PACE OF OIL SHALE DEVELOPMENT

THURSDAY, JULY 17, 1980

U.S. SENATE,
COMMITTEE ON THE BUDGET,
Denver, Colo.

The committee met, pursuant to notice, at 9:50 a.m., in room 320–E, State Capitol Building, Denver, Colo., Hon. Gary Hart presiding.

OPENING STATEMENT OF SENATOR HART

Senator HART. Ladies and gentlemen, this hearing by the Senate Budget Committee will come to order.

We appreciate your presence here. The subject of our hearing this morning, as I'm sure you all know, is the question of the development of Colorado's oil shale resources and, most particularly, the timing and scope of that development. As I'm sure you also all know, Congress has recently passed a proposal for the development and fairly speedy development of a domestic synthetic fuel industry.

I think we also all agree that we face rather grave danger in these days of being drawn in the war in the Middle East to protect the supply of oil from the Persian Gulf OPEC countries. And, of course, Colorado is anticipating energy development of an unknown and certainly unprecedented scale.

OIL SHALE INDUSTRY FOR COLORADO A CERTAINTY

There is no question in my mind that Colorado will have an oil shale industry. Our dangerous national security and economic situation demands it. There is also no question in my mind that the development of an oil shale industry will require certain sacrifices by the people of this State. God has seen fit to bless the State of Colorado with enormous abundant energy supplies, most particularly, of course, oil shale. At the same time, he has seen fit to bless this State with extraordinary natural beauty and productive farmland and an industry based on both.

I think the real question is whether Coloradans will be called upon to make a sacrifice over and above what other citizens of this country will be called upon to make and whether in the process of developing those energy supplies we will have to sacrifice our agricultural, recreational, economic bases as well as the quality of our life. I think Coloradans are willing to assume their share of sacrifice to meet our Nation's energy goals. The real question is whether we'll have to undertake to assume more than our share of that sacrifice.

SIZE, SCOPE, AND PROGRESSION OF OIL SHALE INDUSTRY

As I've indicated, the focus of today's hearing will be on the size and scope and progression of that oil shale industry. And the focus more particularly will be on the recent projections by the Exxon Co. of what kind of synthetic fuel in the oil shale industry we should have. Exxon has projected a development of about 8 million barrels of oil from shale resources in western Colorado and eastern Utah in the next 30 years. To put that in perhaps more understandable terms, that undertaking would require a mining operation five times greater than all of the coal mined daily in the United States today. The processing of the rock would require the construction of over 150 oil shale plants each the size of a large oil refinery or steel mill. The people to work in and supplement these operations would increase the population base of the western part of this State from about 75,000 to over 1½ million.

While we know oil shale will bring dramatic changes to our State, both good and bad, these projections are, of course, staggering. The size of oil shale development that Exxon has projected for our State is about 800 percent greater than any projection we've seen before. Because of this, Exxon's testimony today is, of course, vital to the Senate Budget Committee's hearings and our determination with regard to the role the Federal Government would play in the financing of these operations.

We will also be hearing today from the State of Colorado focusing on the role of the State in oil shale development and the State's view of how fast and how large the industry should be here in Colorado. We'll also be hearing from the Environmental Protection Agency on the effects of various levels of shale development and from the Department of Energy on what kinds of realistic projections can be made about oil shale and government assistance for development of the industry. We'll also be hearing from the Rocky Mountain Oil and Gas Association on its views on oil shale development in this State.

This hearing is intended to open a dialog about the size and timing of oil shale development in the State of Colorado. For too long I think this dialog has been limited to Government and industry. I think it must now begin to involve all Coloradans for it has to do with the kind of State that each of us will leave in future generations.

Our first witness this morning will be Mr. William Slick, executive vice president of Exxon Oil.

Mr. Slick, I want to thank you for being here today. Your testimony will be of extreme interest, of course, to all of us as Coloradans and I think of great importance to the Senate Budget Committee in our deliberations about future Federal financial assistance to the synthetic fuels industry.

As you know, our principal concerns here today are your projections in light of the impact of your proposals particularly on this State and region with particular emphasis on the natural resources and environment as well as human resources, the communities being involved in energy development. Your comments in this regard will, of course, be very helpful to us. I must say that as one Coloradan, Exxon's proposal took me somewhat by surprise and took me off my feet. I have had the opportunity since the proposal was announced to meet with your president, Mr. Meyer, and others of your organization as I think the government of this State has and others.

As I indicated briefly a minute ago, this hearing is to open a discussion of dialog to bring as many citizens of this State and other interested parties into the discussion as possible. So we appreciate your presence and look forward to your testimony.

STATEMENT OF W. T. SLICK, JR., SENIOR VICE PRESIDENT, EXXON CO., U.S.A.

Mr. **Slick**. Thank you, Senator. Just for the record, I am a senior vice president of Exxon Co., U.S.A. We do appreciate the opportunity to present our views to you as part of this opening of the dialog as you mentioned.

As an integral part of our business planning efforts within Exxon, we have annually for a long number of years prepared an energy outlook. And in recent years, we've seen fit to make that outlook public. Last year for the first time in this process we extended our projections out to the year 2000. And that latest outlook reflecting as it did the changing nature of the energy situation in the world, the politics of energy, and the economics of energy showed a significant role for synthetic fuels in America's future. In order to better understand that role, we then extended that work on a longer term basis and tried to look out into the middle of the next century to try to put the whole thing in perspective.

We have published both of those studies. And we've begun the process, which I think is consistent with your calling of this meeting of trying to discuss these assessments with leader in both the public and private sector. I'd like to submit copies of both those studies for the record.[1]

I'd like to make some summary comments taken from them after which I then want to suggest some major areas of effort that we think this country is going to have to undertake if it is in fact going to realize the full potential in the area of synthetic fuels. Before doing that, I feel compelled to try to set the record straight with respect to those studies.

We are in fact pleased that they have, as you suggest, stimulated the process of public debate. But, unfortunately, some have misunderstood both their purpose and their message. They do not constitute an Exxon plan as some have characterized them for solving the energy problems. Nor do they outline a major project upon which Exxon has embarked. They are rather, quite simply, our assessment of the extent of this country's future energy needs and what we believe is possible should the country in fact choose to take advantage of its tremendous potential for synthetic fuels.

THE ENERGY TRANSITION

As we see it, the United States and the world are really in the early stages of an inevitable energy transition, a transition from a petroleum-dependent economy to an energy-diversified one which will eventually become more and more reliant on nondepleting fuel sources.

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[1] See p. 256.

Now, there are many unknowns about this energy transition, as to how it's going to unfold, what it's really going to amount to. But there are some important things that we do know. We know, for example, that the transition in our country actually began a number of years ago when the United States began consuming oil and gas from domestic sources faster than we were finding them. We know that even the major oil exporting countries around the world, the OPEC countries in the Middle East which have the greatest known petroleum reserves, will begin to have their own transitions and declines in the next two or three decades. And we know that some time in the next century the world will have to rely substantially on nondepleting or renewable sources of energy. However, I suspect that the most important things are the ones that we don't know. Among the unknowns is whether or in fact when we as a nation will develop a clear commitment to improve on our energy situation.

Now, one would have thought that the 1973 and 1974 Arab oil embargo and recent events in Iran would have been taken as sharp and painful warnings in this country. But in spite of those events, we have continued to muddle along without agreed upon objectives or without effective actions to deal with our energy problems over the longer term. This muddling along cannot continue without severe risks to both our economy and, as you indicated earlier, our national security.

There is a great public confusion in this country I think as to what the solutions to our energy problem are. Each interest group has a different favorite. There are those who advocate solar power or conservation or coal or nuclear power or additional conventional oil and gas or synthetic fuels or some combination of several of those or even all of these. And herein I think lies a basic paradox in the energy debate, and that's the fact that this nation does possess a wide variety of potentially large energy sources. And that fact itself actually tends to confuse people as to what the situation is and makes it difficult to settle on a course of action for the future.

Now, as we look to the future and consider what course we want to follow, I think it's imperative that we make distinctions between those sources of energy which can help us now, those that can help us in the decades immediately ahead, and those whose potential is really in the much more distant future. And in that context, I'd like to summarize very briefly some of the findings of the studies which I mentioned earlier and the studies which provide the basis for our conclusion that there is in fact not only the potential but the need for a major synthetic fuel industry in this country.

U.S. ENERGY OUTLOOK

We project that even with significant energy conservation, the total demand for energy in the United States will grow from where it is today at about 39 million barrels a day of oil equivalent to somewhere around 50 million barrels a day of oil equivalent at the turn of the century. In the 1980's and in the 1990's, essentially all of the growth in demand is going to be satisfied by coal and nuclear. We actually see the demand for oil and gas in total declining over the balance of this century. In the 21st century, the demand for energy will continue to grow, albeit slowly. Nondepleting energy sources, such as solar and nuclear fusion, will begin to make contributions to the energy picture as more and more energy is consumed as electricity in this country.

But our studies indicate that there will, nevertheless, be a large segment of demand primarily in the transportation and petrochemical areas which can only be met by liquid and gaseous fuels. Meeting that demand for energy in those forms is going to be of critical importance to our Nation.

We expect, as I indicated a moment ago, that the demand for oil and gas itself will decline. However, the ability of the United States and, in fact, eventually the ability of the world to produce oil and gas from conventional sources is also going to decline. Today, our demand in the United States for oil and gas taken together is about 28 million barrels a day of oil equivalent. About 20 million of that comes from domestic sources. The other 8 million is imported. By the year 2000, we think our demand for oil and gas will be down from 28 to 25 million barrels a day of oil equivalent. But at that time, we see domestic production providing about 12 million barrels a day. And that leaves a gap or difference of some 13 million barrels a day of oil equivalent. That difference, that gap, can be covered by imports, or it can be covered by synthetics.

Early in the next century, that gap will grow a little bit. It will get up to about 15 million barrels a day. And, as we see it, it will stabilize at that level at least through the middle of the next century. Clearly, these projections are subject to wide variations, and I would not suggest to you the contrary.

The essential point is that, for many decades to come, there will be a large demand for energy in liquid and gaseous forms which cannot be satisfied by domestic production of conventional oil and gas. Synthetics, we think, are one way to meet that challenge. Trying to look that far out in the future, we think, addresses a very important national policy question, and that is whether or not the large commitment of resources of all kinds that it would take to develop the major synfuels energy would be worth it. As we see it, this is not an industry that will come up and down in a short period of time. It's a long-term commitment. And, we think, clearly the effort will be worth it.

SYNTHETICS INDUSTRY

Now, having in that way established a long-term need for synthetics, we then have asked ourselves how large an industry could be developed? What is possible? What would it take? To address that general question, we had to break it down into several key issues.

RESOURCES

The first one was the question of resources. As you indicated at the outset, we have tremendous resources in this country, in this State. And, without going into detail, our studies suggest that there is enough oil shale and coal reserves in this country to produce 15 million barrels a day of synthetic fuels for a period of 175 years; in other words, there's a tremendous resource base out there. And I don't think we need to debate that issue very much. Our projections, as you indicate, suggest that 15 million barrels a day would be split between coal and oil shale, 8 million from oil shale and 7 million from coal. That's in both gaseous and liquid forms.

Senator HART. Excuse me a second, Mr. Slick. We would agree also that the coal base geographically is widely distributed, and the oil shale base is highly concentrated.

Mr. SLICK. Yes. But a significant piece of the coal—synthetics—would probably be in the West. Our studies suggest it's roughly about half and half in round numbers, West and East.

Senator HART. Again, West covers a lot of States.

Mr. SLICK. Mostly Wyoming and Montana, southern Colorado. And oil shale is mostly Colorado and Utah.

Senator HART. Precisely.

TECHNOLOGY

Mr. SLICK. And we looked at the technology question, and we found that in our judgment there were a number of processes that industry is indicating are ready for commercial application. There are some others that are still in the research and development stage. Specifically, with respect to oil shale, there are several surface processes that are operating successfully in large plants. And the technology we think is ready for scaling up to commercial size.

Following the first commercial-size plants, we can expect improvements in operating efficiency of oil shale plants, improvements in the economics of those plants as the technology for producing oil shale matures. But our experience in petroleum refining has shown that the first generation of plants do not become obsolete as the technology evolves. Rather, they are modified, they are upgraded, they are made more efficient by incorporation of the new and evolving technology.

To illustrate that point, I checked back into our history. We have three major refineries in the United States: Bayway, N.J.; Baton Rouge, La.; and Baytown, Tex. We have two smaller ones, one in Billings, and one in Benecia, Calif.

One of the three major refineries was built in 1908 and the other two were built in 1909. And those three refineries that are over 70 years old are still efficient competitive refineries, because they have evolved over that period of time by incorporating new technology as it comes out. We think that's the kind of process that will take place in the development and growth of the oil shale industry.

So given the country's need for synthetic fuels production, we would anticipate that the second generation of plants, if you will, would be in the design and even in the construction phase as those first plants were coming onstream. And we really see little to be gained by arbitrarily delaying that process.

Senator HART. Could you relate generations to time and also size? I think in your studies that I've looked at what is missing is the progress, the scaling up, how many plants are first generation and then how many are added after that and at what time.

Mr. SLICK. I don't have numbers at my fingertips. You can go back in the history of this country, and there were surges in the development of refining capacity.

Senator HART. I'm sorry, for the 8-million-barrel-a-day oil——

Mr. SLICK. Senator, if I might delay, I'm going to get to that buildup a little bit later in my statement.

Senator HART. Thank you.

AVAILABILITY OF CAPITAL

Mr. SLICK. The third question we looked at was capital; can sufficient capital be raised to build these large synthetic fuel plants and a major synthetic fuels industry. Commercial-size synthetic fuel plants are going to be very expensive, something beyond what we've ever seen in the past. We estimate that a typical 50,000-barrel-a-day plant is going to cost between $3 and $4 billion in "as spent" dollars. If you do the arithmetic, the investment required to achieve the production level of 15 million barrels a day of synthetics in this country would come to some $3 trillion, admittedly a mind-boggling figure.

But despite the magnitude of those investments, we believe they are manageable since they would be spread over a 30-year period of time. The capital markets in this country have demonstrated time and again that, given sound investment opportunities, the necessary capital is forthcoming. The annual investment that it would take in developing a synthetics industry of this nature during the peak years of construction would represent about 1 percent of GNP. Or put another way, that's about the level of investment that the domestic petroleum industry now makes every year in the upstream end of the business looking for conventional oil and gas.

TIMETABLE FOR DEVELOPMENT OF SYNFUELS

I think it is important to recognize the time table for the development of synthetic fuels which you mentioned just a moment ago. The first plants as we see it would not come onstream until the middle 1980's. Several studies by us and by others have estimated that the level of synthetic fuels production in 1990 will be about a million barrels a day. These estimates seem to us to be consistent with reaching or at least coming close to the national goal of 2 million barrels a day that was set by the administration and the Congress for 1992 in the Energy Security Act.

If you look specifically at oil shale, which you mentioned, our scenario projects a buildup in production to about 600,000 barrels a day in 1990, 1½ million barrels a day in 1995, and 3 million barrels a day by the turn of the century, growing to an ultimate level of 8 million barrels a day. Or put a little bit differently, if you look at this 30-year time period during which this industry would be developing, during the first half of that time period, about 20 percent of the volume would come on stream; during the first two-thirds of it, about 40 percent would come on stream. So it's something that accelerates as you go along.

LONG-TERM POTENTIAL OF OIL SHALE INDUSTRY

Senator HART. Can you translate that into numbers of plants? I believe your 150 plants are projected at about 150,000-barrels-a-day projection, or——

Mr. SLICK. The 150 number, Senator, if I might correct you, is not a number we've really ever projected. The 150 number is what you get if you divide the oil shale volume by the 50,000 barrel-a-day kind of number. What our study projects is that initially oil shale would be developed mostly by room and pillar mining and surface retorts, and those would be 50,000-barrel-a-day plants.

RESOURCE RECOVERY

In the longer term, to realize the potential of this industry, we think it would have to be developed in large surface mining operations in the Piceance Basin primarily because of the tremendous difference in resource recovery that you get if you mine through surface mines as opposed to room and pillar mines. You leave so much in the ground in the room and pillar mine that it's a highly questionable use of the resource to go at it that way over the longer pull. I think the industry will start in primarily room and pillar operations but would go to large surface operations longer term. For instance, in our projected case, there were six 1-million-barrel-a-day surface mining plants. So if you take 6 million from surface mining out of that 8 and divide the other 2 million by the 50,000 barrels-a-day, it doesn't come out right.

Senator HART. Wait a minute. That last set of numbers was very important. Run back through that again.

SURFACE MINING OPERATIONS

Mr. SLICK. We see an ultimate level of 8 million barrels a day in this particular case that we worked out to see what the potential is. In the latter stages of development, the major portion of the production comes as the result of surface mining operations. In fact that adds up to some 6 million barrels a day. And the reason that you go that route is because the recovery of the resources is so much higher.

NUMBER OF PLANTS NECESSARY TO MEET PROJECTIONS FOR 1990

Senator HART. I understand. Let's start back at the front end. You're projecting 600,000 barrels a day of oil shale by 1900.

Mr. SLICK. Yes.

Senator HART. How many plants would that be?

Mr. SLICK. It would be about a dozen.

Senator HART. Twelve plants by 1990.

Mr. SLICK. If they're in the 50,000 barrel a day.

Senator HART. And you think at this stage of the process——

Mr. SLICK. Probably. There would probably be plants like that. Where it goes from there is open to conjecture. And you get into the definition question, what do you consider a plant.

Senator HART. I understand. A unit, whatever you want to call it. What we're here today trying to do is to quantify this whole thing. In 5 years you go to 1½ million which is an increase of about 150 percent. Is it safe to assume you're then talking about 30 plants?

Mr. SLICK. If you're still at the 50-000-barrel-a-day level. That's an assumption. I don't know whether you will or not.

Senator HART. So the increments——

Mr. SLICK. And about that time we think you would begin surface mining operations.

Senator HART. The massive surface mining operation. So to reach the 3-million-barrel-a-day level by the year 2000, end of the century—I'm doing quick mathematics—you'd probably have in the neighborhood of about 60 plants or units of that size.

ULTIMATE SIZE AND SHAPE OF SYNTHETIC FUELS INDUSTRY INDETERMINABLE

Mr. SLICK. Again, Senator, you're making an assumption I won't make with you, that over a 30-year period of time the modular size stays 50,000 barrels a day. I don't know what it will be. We think this volume in the aggregate of synthetic fuels from oil shale is reasonable. The plants may be 100,000 barrels a day, 150,000 barrels a day. At one time in this country we built oil refineries that were major units that were 10,000 barrels a day, and now people are building refineries that are an order of magnitude different than that, two orders.

Senator HART. I understand. All we've got is 1980 data to work with. Using 1980 data, let me see if I can state the case using your numbers.

Mr. SLICK. Let me throw one other piece of data on the table. In terms of the impacts on population, air, on water, the thing that is significant is the volume of oil shale you're producing, not the number of units. And what we're saying is that in 30 years this industry could grow to 8 million barrels of oil a day.

Senator HART. All right. But using the increments you're suggesting here, 600,000 barrels a day in 1990, 1½ million in 1995, 3 million barrels in 2000, using 50,000-barrel-a-day modules, that would mean that you would have in those incremental years, 12 modules, 30 modules, and then 60 modules; is that fair?

Mr. SLICK. If they came on that way.

Senator HART. Or some combination thereof. I'm not trying to lock you into 50,000-barrel-a-day plants. I'm trying to get some perspective.

Mr. SLICK. Well, I also don't want to be locked into the number of units either, Senator, because I don't know what that number is, whether it's 50,000 or 150,000 barrels a day. It has a direct ratio impact on the number of units that you're building to——

Senator HART. But theoretically, you could have three huge plants?

Mr. SLICK. Theoretically; but I don't think it would go that way.

Senator HART. Or 120 little ones.

Mr. SLICK. If you look at our projections, our projections for 1990 aren't much different from anybody else's. The only thing we've done is we've tried to go beyond 1990. I know of few if any other studies that have done much work in that area. The first time you look at something like this, unquestionably it's rather startling. It was startling to me.

Senator HART. It was startling to me. I'm sorry, go ahead.

FLEXIBILITY ESSENTIAL IN PLANNING FOR SYNTHETIC FUELS INDUSTRY

Mr. SLICK. We don't know. We're not here to tell you that we know what the ultimate size, shape, or description of this synthetic fuel business might be or where we will ultimately get. But we do believe it is important that as the Nation plans for a synthetic fuels industry, it does so in such a way that it can in fact reach its ultimate as opposed to starting off in a way that precludes ever getting to where we want to go. I don't know where we're going to end up. That's a decision that has to be made by many, many people. We just need to start in such a way that we don't lock ourselves into something.

INFLUENCING PARAMETERS ON DEVELOPMENT OF SYNFUELS INDUSTRY

Now, when we went through this effort, our studies looked at many parameters that were going to influence the ultimate size and shape of the synfuels industry. We don't think that the ones we've already mentioned, technology, resource base, and capital availability, are going to me limiting. I would hasten to add, however, that in the case of the latter two particularly, Government policy, depending on how it unfolds, could make some of those parameters limiting.

As for the other parameters, we believe that realizing the timely development of our full synfuels potential is going to require a coordinated effort of the private sector and Government at the local, State, and national level. It's not an overstatement in my judgment to say that it will in fact require a commitment of the magnitude that has never been achieved in the peacetime of the history of this country. I think that characterizes what that assessment is all about.

Fortunately, if we really want to do it and if we get on with it, we've got the time to get it done. This thing seems to fit with the long-term projections we've made.

Four example of other parameters involving oil shale which have their counterparts in western coal and western-coal-based synfuels I think will serve to illustrate the point I'm trying to make. The first is the need for water. A number of studies including our own suggest that water from local sources on the western slope would permit the continuous development of an oil shale industry through the late nineties up to a level of 1½ to 2 million barrels a day. Beyond that level, interbasin transfers of water would be required. Such innerbasin transfers seem to us to be physically feasible. From a financial point of view, the base load cost of interbasin water transfers would represent a very small percentage of the ultimate cost of synfuels that would be borne by the synthetic fuels industry, and so financially we think they're feasible.

This kind of an approach would, in fact, make it possible to size the facilities in such a way as to bring incremental water for agricultural or municipal or other purposes into the areas as you're bringing the water into a synfuels industry.

RATIO OF WATER CONSUMPTION TO ENERGY PRODUCTION

Senator HART. Could I ask you about the water? What assumptions do you make to reach your conclusion that there is sufficient water in the basin in Colorado for 1½- to 2-million-barrel-a-day operation? That is to say, what ratio of water consumption to energy production do you have?

Mr. SLICK. We think these are pretty conservative estimates from that point of view. Our studies used 3.6 barrels of water per barrel of output. We think that's a very conservative number. We think as the technology evolves that number can go down. It can go down by as much as 50 percent I would suspect. It could get down in the 2 range. We don't think that's unimaginable. But assumptions include upgrading on the western slope. We haven't crossed that bridge. I, quite frankly, question whether upgrading of all of this material would be done on the western slope. If we did it someplace else, that too cuts the water needs down.

Senator HART. Upgrading being what?

Mr. SLICK. Upgrading going from a raw material which you could feed into a refinery to finished products that you could use in your home or your automobile. In other words, going all the way to the finished product.

LOCATION OF OIL SHALE REFINERY

Senator HART. So you leave open the question as to where the shale oil will be refined?

Mr. SLICK. I leave open—my intuition tells me that the economics would not suggest replicating on the western slope 8 million barrels a day of refining capacity while you're idling that much refining capacity somewhere else in the United States. My intuition tells me you put this material in shape where it can be transported and then send it to existing refining centers in the upper midwest or gulf coast or even maybe the west coast.

Senator HART. But theoretically, of course, one could reach the other conclusion that refining onsite or near the site is a possibility also.

Mr. SLICK. It's a physical possibility. And in order to have a conservative estimate as to whether the water piece of this puzzle fits together, we assume that was it just for that purpose. And we took what we thought was a rather conservative look at how much water you need. As I say, we think these are outside numbers as to the figures we took.

USE OF UNUSED OR UNAPPROPRIATED WATER

Senator HART. Did your water calculations limit themselves—when you say sufficient water for 1½ to 2 million barrels a day, is that unused or unappropriated water?

Mr. SLICK. As far as having it in its unused—well, I can't say unused or unappropriated. It's industrial water that's available. It would include transferring some water from agricultural purposes to industrial purposes, so there would be a transfer of water rights.

Senator HART. How much?

Mr. SLICK. I can't give you that detail. I can get it for you, but it's not on my finger tips. It's consistent with Colorado's use of water in the compact arrangements on the Colorado River system.

Senator HART. In other words, it's not——

Mr. SLICK. It's not taking water downstream and pulling it upstream.

Senator HART. But right now you do not know how much of that water is presently being used for agricultural——

Mr. SLICK. It's in our studies. I don't have that detail at my finger tips. I'll be glad to get it for you.[1]

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[1] See letter to Senator Hart, p. 21.

Senator HART. Would you, please.

Mr. SLICK. Certainly.

INTERBASIN TRANSFER OF WATER

One final comment on water. As your line of questioning suggests, there are few subjects that are of greater concern in the West than water, and we recognize that. Interbasin transfers are not new, but they've always come only after long and difficult debates and discussions. If this country decides to develop a project for synthetic fuels that's going to require interbasin transfers, then it's going to require the active involvement and participation of the affected States, of the regions that are involved, and of the Federal Government.

We're talking about a late 1990's timeframe for the interbasin transfer if this thing evolves in that direction which suggests to us that the whole thing is doable if we got after it and start right now. What we think the real challenge is at this time is to try to create action groups that are interested in developing plans to see how you'd implement this thing as opposed to further studies to define constraints. Because I think if you just want to define constraints, we can all sit down with a yellow pad and get enough of those to shut this thing off tomorrow.

SOCIOECONOMIC IMPACT OF DEVELOPING SYNFUELS INDUSTRY

The second issue that I'd like to address is the one of infrastructure and social impact. I might say at the outset we applaud your efforts on community impact assistance legislation, and we'd be pleased to work with you in whatever way you think might be useful to try to get that kind of legislation passed.

I must hasten to add, however, that in light of the potentially large growth of an industry over the coming decades that even more assistance for the affected communities is going to be needed than is proposed in the legislation or than is contained in other existing programs.

Now, in my judgment there are many companies in the industry involved in synfuels that are sensitive to and recognize a responsibility to help mitigate these socioeconomic impacts. Certainly we do. I noticed a little bit of a wry smile on your face. That, obviously, is going to be a debatable issue. But nevertheless, we think we do. We think that planning for these impacts and creation of the necessary infrastructure is something that is only going to come about if you involved a large number of constituents, not just the producing companies but the people in the local areas, government at local and State levels. I think you need to get the academicians and think tanks involved.

It's probably going to be necessary to create some new entities to try to coalesce some of these constituents into a results-oriented activity if we as a nation are in fact going to deal effectively with those aspects of it. Not the least of those problems is front-end funding, as you know only too well in your legislative arenas.

Senator HART. The wry smile was only the difficulty I had in getting that modest program passed. And when you say that much more needs to be done, I couldn't agree with you more. I don't know how you get much more done when you can't even get the modest sort I've been trying 3 years past from the Congress.

Mr. SLICK. The frustrations of that legislative effort I'm sure were great on your part. And I have to agree with you. You wonder what some people are thinking. But we are going to have to go on in that area and make new strides from wherever we've been in the past if we as a country are going to do this. And I think that's part of the real thrust of what this hearing is all about.

Senator HART. It would be a great help if you could convince the National Coal Association, for example, that this is a worthwhile effort.

Mr. SLICK. We'll take that under advisement.

Senator HART. I appreciate it.

ENVIRONMENTAL IMPACT OF LARGE-SCALE INDUSTRY

Mr. SLICK. The third factor I want to touch on is the environmental issues. These are issues which must be addressed in much greater detail than they have up until now. We've done some work, but we have not undertaken the fully detailed studies that are going to be needed to assess the impacts of a large-scale industry. Baseline studies and related environmental impact work should begin now for a large-scale industry. If in fact a multimillion-barrel oil shale industry is to develop, the environmental impacts cannot logically be assessed by extrapolating models created to study the first one or two plants, if we're trying to evaluate the impact of a mature industry that evolves over a 30-year period of time, an industry in which the control technology is going to evolve along with other things as well.

Senator HART. Could you in the short history of environmental modeling and a real consistent approach to the solution of environmental problems cite an instance in which an industry or where the effects of the development of an industry have turned out to be less than expected?

MODIFICATION OF CLEAN AIR ACT NECESSARY FOR FULL PRODUCTION

Mr. SLICK. Well, I think maybe the most useful comment I can make in the context that we're discussing the question is that the results of modeling studies done by EPA have suggested that the volume of oil shale that can be produced consistent with the provisions of the Clean Air Act and not violating PSD increments ranges from some early work at 200,000 barrels a day up to numbers that are now at 400,000 and suggesting 800,000 and moving on to 2 million. In other words, that work has evolved over a period of time suggesting there's a full order of magnitude difference than the results that are gotten as the work with the modeling has progressed, as some of the assumptions on the front-end change.

I'm not a modeling expert, and I wouldn't propose to get into the detail beyond that. But I would say, as I've tried to say here, and I think modeling experts would agree, if you're looking at an 8-million-barrel-a-day industry spread over that Piceance basin, then where the plants are is important, whether you take into account the topography is important, the model assuming you're in one plane is a lot different than what the real world is out there. There's a lot of work that has to be done.

My main point on the environmental effort is that we have to get on with that. We should not waste a lot of time debating whether the work needs to be done. It clearly needs to be done. It looks to us like if you're going to go the full route of the 8 million barrels a day, that it will be necessary to modify the Clean Air Act. Now, I recognize when I say that that just makes some people's hair stand on end. But I think that's a judgment that this country has to make, because our studies suggest that it will take some modification of the Clean Air Act, but you can build an industry of this kind without violating the primary standards of health and safety on clean air.

The secondary standards are another question, and that's where the modification would have to come in. I think the point is the baseline work, the modeling work, needs to get on now to where we can assess what really has to take place. As we make the other judgments on the other factors that I've mentioned to try to come to a consensus in this country, do we want a major synfuels industry or not, which way do we want to go, we've got some choices ahead of us. And fortunately, as I suggested, we're talking about evolving something over a 30-year period of time. So it's not something that has to be done tomorrow, but we have to start if we're ever going to get where we're going.

FEDERAL LEASING POLICY

The final parameter I mentioned is the one of leasing policy. The Federal Government, as you well know, controls much of the Piceance Basin. And Federal policy on leasing in the Piceance Basin must be geared to whatever long-term expectations the nation finally sets for itself for an oil shale industry. A piecemeal approach is just not going to suffice.

Along this line, we're inclined to commend the Department of Interior for their recent initiative to expand the prototype leasing program and to try to structure a permanent leasing program. For the oil shale industry to develop consistent with the scenario that I've outlined, a permanent leasing program must be put in place within the next few years and must include leases of the appropriate size in the basin to accommodate the large-scale surface mining operations that I've suggested.

We support the efforts to remove the Federal limitation of 5,120 acres per company, and we think some steps have to be taken to provide for off-lease disposal of spent shale as part of the siting approach. The efforts you've been associated with on the first prototype leases is a good start, but I think that concept has to be broadened to fit this total industry.

In conclusion, the United States clearly in our judgment has the potential for a major synfuels industry. The degree to which we realize that potential is going to depend on decisions by many people, people in and out of Government, people in and out of Colorado. The country's potential can be achieved we believe in ways that are socially, environmentally, and politically acceptable.

The first step in the process is to expand the public discussion, to involve those who will be directly affected, be they citizens of the area of potential synfuels production or that broader group of citizens in this country who are affected by the impact of the $90 billion drain on our economy by oil imports or who would be affected if those foreign imports were suddenly cut off.

We view these hearings as a part of that process, and we commend you for having them. And we particularly commend you for having them here in Colorado, which, as you said at the outset, is destined to play such a key role in the Nation's energy future. Senator, I'm pleased to be here, and I would be pleased to respond to any further questions you may have.

BURDEN OF DEVELOPING SYNTHETIC FUELS INDUSTRY ON COLORADO

Senator HART. Do you think the proposal which you've outlined here today would place an extraordinary burden or sacrifice on this State?

Mr. SLICK. Well, first, it's not a proposal. It's a view of what the potential of this country is. And the question of burden I think is a relative one. I'm not going to sit here and tell you that you can develop this kind of an industry without changing the western slope. That would be preposterous on its face.

I have suggested what that area is going to look like in the future, how this thing is going to evolve. These decisions are not Exxon's to make. They're decisions for a broad cross section of people to make. Quality of life is like beauty, you know. It's somewhat in the eye of the beholder. For some people, quality of life means backpacking in the hills. To other people, quality of life means expanded job opportunities. And I can give you a whole spectrum of things in between. It's going to be different.

The people involved in this State, this country, are going to have to make a judgment whether they like it that different way or if there's some other alternative.

DEVELOPMENT OF OIL SHALE RESOURCES

Senator HART. In some respects you're correct and other respects 20 or 30 percent of the oil shale resources are in private hands. That means the owners of those resources can do pretty much whatever they will within the bounds of Federal law or if they're able to get Federal law changed. So we here in this part of the country, and particularly we here in Colorado and particularly the western part of Colorado see ourselves on the one hand as participants in that national decisionmaking you're talking about, given our population strength, certainly not major participants.

Given the fact that a certain sizable portion is outside the control of the Federal Government and its elected officials, somewhat victims, if you will, if the thing goes wrong. Beneficiaries if it goes right and is done right, victims if it isn't and with much less control of how the private development takes place. I don't think any of us are naive enough to believe that development of an oil shale industry is going to be the result of some national town meeting or whatever. There are going to be a lot of private corporate decisions made and going to be a lot of heavy lobbying of the Congress and State government for one concession or another. I think it's those joint processes that concern those individuals, particularly western Coloradans.

Mr. SLICK. If I might interject? I think you're a little bit modest in your statement of how significant a role Colorado can and will play in the processes. I agree with the statement you made.

Senator HART. Well, we have 7 out of 535 members of Congress.

Mr. SLICK. But there are many issues that can only be decided at the local, country, or State level that those 535 people in Washington are not going to get directly involved in. They set a broad framework. But there are many decisions made in Colorado. The people of Colorado and the government of Colorado are going to be very active participants in the process, be they projects on private lands or on Federal lands.

IMPACT OF WINDFALL PROFITS TAX ON EXXON'S RECENT PURCHASE OF OIL SHALE INTERESTS

Senator HART. When did Exxon acquire its principal recent oil shale interests?

Mr. SLICK. I'm not sure what's behind your question.

Senator HART. There's nothing behind it. I'm just asking. The recent purchase from Arco.

Mr. SLICK. The purchase from Arco is still in the negotiating stage. That has not been locked up. That process started this spring. It started long after we started discussing this white paper that's caused so much interest.

Senator HART. To what degree was the decision to undertake those negotiations for that purchase the result of the passage by the Government of the so-called windfall profits tax legislation——

Mr. SLICK. Unrelated.

Senator HART [continuing]. Containing substantial incentives for the synthetic fuels industry and a subsequent passage of the law establishing the Energy Security Corporation——

Mr. SLICK. Unrelated. We think with the possible exclusion of the investment tax credit piece, there's nothing in the Synthetic Fuels Corporation bill that influenced our decision whatsoever. And the economics of this thing are enhanced by that bill. Obviously they would decline if the bill hadn't been passed. As far as the Energy Security Corporation is concerned, we really quite frankly see nothing in that that couldn't be done without passing the bill.

Senator HART. I don't necessarily quarrel with that. On the other hand, when you talk about muddling along, we have to muddle along for some of the reasons you've suggested. On the other hand, we the Government have taken some steps. My question was whether those steps had anything to do with your decision.

Mr. SLICK. They had on impact other than what I mentioned. They did not impact our decision to pursue the Colony project.

AMEND AIR QUALITY STANDARDS

Senator HART. Now, on the question of air quality, have your studies been somewhat more specific on the degree to which the Air Quality Act would have to be amended? You said I think a fairly important thing, primary public health standards would not have to be changed. We may hear some later witnesses who will quarrel with that. But secondary standards may have to be altered. Have you anywhere in your studies been more specific as to how they would be altered?

Mr. SLICK. The only other specific that I would give you is that in the act as it exists today, the PSD–1 areas, as we understand it, are locked in by legislation. And you cannot go from 1 to 2. You can go from class 2 to class 3. I think other witnesses will probably testify as to the potential impact of the oil shale industry on the Flattop Wilderness Area which is one of the PSD–1 areas. That one is going to have to be looked at. That may be one of the ones that would have to be changed in legislation. The PSD–1 goes well beyond the primary health and safety standards and gets into secondary standards.

AIR QUALITY IN DENVER

Senator HART. But for the layman who's not up on these details, even the maximum industry which you're suggesting, 8 million barrels a day by the year 2050 or whatever, that's not going to degrade the air quality in Denver or anything like that, is it?

Mr. SLICK. No, not in Denver. You know, I can't really imagine transport over that length of distance that would be significant without dispersion. That's what these models were all about. And some of the modeling work says when you get about 25—I don't remember if it's kilometers or miles—from one of these plants, the dispersion level is much it's no longer a problem. And these same studies also say it depends specifically on where you put the plant and what kind of plants they are.

As I suggested earlier, I don't think the plants that would come on stream in the year 2000 are going to look like in many different respects the ones that come on stream in 1985. They're going to be different in character and mechanics and process and discharge, in the discharge control technology. So this is going to be a process that evolves. I think that's important. That's a point that cannot be overemphasized.

We're not talking about 8 million barrels a day coming out of the ground tomorrow. We're talking about an industry that grows over a 30-year period of time before it matures.

ENERGY REQUIREMENTS FOR WATER TRANSFERS

Senator HART. Now, your previous briefings to me as well as your statements here today indicate if your interbasin water transfers were to transpire, they would probably be from that Missouri River basin and I think more specifically the Oahe Reservoir in North Dakota and the transported water would be pumped to western Colorado. And the power for those pumps is to be generated by three 1,000-megawatt powerplants. What would be the energy requirement to operate those plants?

Mr. SLICK. I don't have that figure. I can get it for you.[1] Obviously, it would take energy to pump that water. The case that we worked again was an upside case. There are not very many long distance—at least this distance—interbasin transfers that were done by closed conduits by pumping. But we said, you know, let's work that case. Because if you're going to find out whether—if that case will work, anything intermediate to that case will work.

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[1] See letter to Senator Hart, p. 21.

Senator HART. Well, my obvious question is: How much energy is it going to take to get the water here to produce energy? The calculations I think EPA or someone else have done is it's equivalent to about 180,000 barrels a day to operate the three powerplants which is equivalent of about three oil shale plants.

ENERGY CONSUMPTION OF SYNTHETIC FUELS INDUSTRY

Mr. SLICK. Let me just stipulate with you that if you look at our total energy projection, that little pamphlet that we have, and look at the industrial sector, you will find that in the 1990 to the year 2000 period, if memory serves me right the industrial sector—I know the industrial sector growth rate goes up. And that growth rate in the industrial energy consumption is attributable directly to the energy it takes to produce synthetic fuels. They are large energy consumers in themselves.

The output that we're talking about, the economics we're talking about, take all of that into account. And what we have been dealing with is the net energy production in this country. In other words, that year 2000 supply-demand balance takes into account the amount of energy that's chewed up in the process, whether it be pumping the water or running the powerplants to pump the water or consuming coal or oil shale or byproducts thereof in the retorting process. So it's all worked into that, and it's a net producer of energy.

It consumes energy at a higher rate, and that's one of the prices this country would pay to get off of the oil imports problem that we have. We would have to consume energy to produce energy, no question about that, much more energy than is consumed in producing conventional oil and gas. And that in itself is one of the reasons that up until now synthetic fuels have not come on. It's a major part of the economics.

Senator HART. That's right. But in rough terms, to supply the water for 150 plants—I understand your reticence of using that figure in that term—the capacity that that number of plants would produce of oil shale, it would require three or four of those plants to pump the water here.

Mr. SLICK. Yes. We visualize three, 9-foot conduits coming all the way from Pierre, S. Dak. That's a major project in itself. As I tried to suggest earlier in working the water problem, that's a need that may evolve in the late 1990's. And if we're going to work that problem, the nature of that problem is such you don't wait until 1994 to get started on it. Because you well know it's an extremely difficult political and emotional problem.

SYNTHETIC FUELS AND COAL PRODUCTION POTENTIAL FOR COLORADO

Senator HART. Two more questions. Of your coal production calculation, 7 million barrels a day of synthetic fuels from coal, how much of that capacity do you project for the State of Colorado?

Mr. SLICK. If you give me just a second, I may be able to find it for you. We have about 700,000 barrels a day from the southern Rockies which would be Colorado and New Mexico. We have about 3 million barrels a day from the Powder River basin which would be mostly Wyoming and Montana. We have 400,000 barrels a day from the Dakotas. So that the West is about four out of that seven.

Senator HART. So 50 to 60 percent of the coal synthetic fuel industry would be located in this region, and a tenth of that might be in the State of Colorado, a tenth of the entire number?

Mr. SLICK. It would be a very small part of the coal in Colorado.

Senator HART. But it would be on top of almost an 8-million-barrel-a-day oil shale?

Mr. SLICK. Yes.

Senator HART. So what you've got is a plan—a suggestion—I won't use plan or proposal—of a 15-million-barrel-a-day production from synthetic fuels, 8 million barrels of which would come from oil shale, perhaps as much as 90 percent of that in the State of Colorado, on top of which perhaps a tenth of the 7 million barrels a day from coal might also be located in Colorado.

Mr. SLICK. For round number purposes, taking out oil shale in Utah, adding some coal synthetics in Colorado, you're talking about 7½- to 8-million-barrels-a-day potential for the State of Colorado.

Senator HART. Half the synthetic fuels budget, one State.

Mr. SLICK. Yes.

Senator HART. Well, I appreciate this information. I just got back from the western slope. And, of course, these are the front line people where this all is concerned. I indicated to them that I would do my best to bring whatever information of this sort I could to that region, that area. And I would like very much to replicate this hearing this morning perhaps in Grand Junction in the next month or two if we could. Would you be agreeable to doing that?

Mr. SLICK. I would think so.

Senator HART. Thank you very much. I appreciate your presence.

NEW CONSENSUS NEEDED TO REALIZE POTENTIAL OF SYNTHETIC FUELS INDUSTRY

Mr. SLICK. If I might, Senator, just by way of conclusion, because I think that what I've tried to say today is what it's going to take if we're going to realize the potential. That's a big if, and that's a question that this country is going to have to decide. I think really it is not much different than some of the things that you have said right here in this State. I think we have a pretty common ground to stand on, because in your comments in Denver earlier this year, you talked about a need for a new consensus. That's really what we've been suggesting, there's a need for a new consensus. There's a whole disparate group of people that have not worked problems together before that if this thing is going to evolve are going to have to work problems together. And that's a choice that we have to make. It's a choice that's going to be made by Coloradans; it's going to be made by Americans; it's a choice that has to be made by the public sector and private sector working together. Because only if you pull that kind of a consensus together is there a prayer of realizing this kind of a potential. We recognize that and hold it out for nothing more than that.

You made a comment, and I agree with you, it's not useful to have a wish list. This is not even a wish list. What you need to do is get in and roll your sleeves up and work on the problem. We think this one is worth working.

Senator HART. Those companies that have been involved with the oil shale industry I think in this State would, I hope, testify that I have attempted to all reasonable degrees to work with them in developing that consensus. The reason we're holding this hearing today is this suggestion or proposal or whatever goes well beyond, as I indicated in my opening remarks, anything anybody ever conceived of as far as I know in 15 years of following this subject for the oil shale industry.

I also indicated in my opening remarks I don't think there's going to be a consensus which has an industry of this size and scope nationally where half of the results of it are going to occur within one State and one State with a fragile environment. So I agree with you on the consensus. I just don't know where it's going to lead us.

Thank you for your presence here.

Mr. SLICK. Thank you, Senator. I appreciate the opportunity.

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PUBLIC AFFAIRS DEPARTMENT
PLANNING

W. W. MADDEN
MANAGER

August 14, 1980

Senator Gary W. Hart
254 Russell Senate Office Building
Washington, D.C. 20510

Dear Senator Hart:

In his absence, Mr. W. T. Slick, Jr. asked that I transmit the enclosed copy of the transcript of the July 17 Senate Budget Committee hearing on the pace of oil shale development, which reflects our suggested editorial changes to the hearing record. In addition, you raised two questions at the hearing to which we agreed to respond: How much of the existing water on the Western Slope is used by agriculture and what are the energy requirements associated with pumping the interbasin water transfers?

Addressing the first question, the Colorado Department of Natural Resources in the public review draft of their report, "The Availability of Water for Oil Shale and Coal Gasification Development in the Upper Colorado River Basin," estimates that in 1976, the latest year for which data are available, agriculture on Colorado's Western Slope used about 1.2 million acre feet per year, or about 40 percent of the total of 3.0 million acre feet of water annually available. Moreover, it has been estimated that for the same year, about 0.9 million acre feet per year, or about 30 percent of available water, was not being used. Further, under the Bureau of Reclamation's 1990 forecast of water usage on the Western Slope, sufficient unused water is available to meet the growing needs of agriculture, municipalities and other demand sources and still provide for a 1990 oil shale production level greater than Exxon's projections.

Turning to the second question, our studies indicate that roughly the equivalent of three 1,000-megawatt power plants would be required to pump the interbasin water transfers from the Missouri River system. The daily energy requirements for these plants would be approximately the equivalent of 75,000 barrels per day of oil. However, the important point to keep in mind is that the energy for these power plants would undoubtedly be provided by the nation's more abundant coal or nuclear supplies, and thus the full production level of synthetic liquid and gaseous fuels would be available to meet the unique needs for these critically important energy sources.

Sincerely,

W W Madden

WWM:mnp
Enclosure

c: Mr. W. T. Slick, Jr.
Mr. D. E. Smiley

A DIVISION OF EXXON CORPORATION

PREPARED STATEMENT OF W. T. SLICK, JR., SENIOR VICE PRESIDENT, EXXON CO., U.S.A.

MY NAME IS WILLIAM T. SLICK, JR., SENIOR VICE PRESIDENT OF EXXON COMPANY, USA. I APPRECIATE THE OPPORTUNITY TO EXPRESS EXXON'S VIEWS ON THE SUBJECT OF SYNTHETIC FUELS.

AS AN INTEGRAL PART OF OUR BUSINESS PLANNING EFFORT, EXXON PREPARES ANNUALLY AN ENERGY OUTLOOK WHICH, FOR MANY YEARS, WE HAVE MADE PUBLIC. LAST YEAR, FOR THE FIRST TIME, WE EXTENDED THE OUTLOOK TO THE YEAR 2000. THIS LATEST OUTLOOK, REFLECTING THE CHANGING ENERGY SITUATION, POLITICS AND ECONOMICS OF THE WORLD, SHOWED A SIGNIFICANT ROLE FOR SYNTHETICS IN AMERICA'S FUTURE. TO BETTER UNDERSTAND THAT ROLE AND TO TEST ITS LONG-TERM VIABILITY, WE EXTENDED OUR ASSESSMENT TO THE YEAR 2050.

WE HAVE SINCE PUBLISHED THAT WORK AND HAVE BEGUN THE PROCESS OF DISCUSSING IT WITH THOUGHTLEADERS IN BOTH THE PUBLIC AND PRIVATE SECTOR. I HAVE SUBMITTED A COPY OF THESE STUDIES FOR THE RECORD. I WILL MAKE A FEW SUMMARY COMMENTS ON THEIR SUBSTANCE AFTER WHICH I WILL SUGGEST SOME MAJOR AREAS OF EFFORT NEEDED IF THIS COUNTRY IS TO REALIZE ITS FULL SYNTHETIC FUELS POTENTIAL.

BEFORE DOING SO, I FEEL COMPELLED TO SET THE RECORD STRAIGHT REGARDING THESE STUDIES. WE ARE PLEASED THAT THEY HAVE STIMULATED THE PROCESS OF PUBLIC DEBATE. UNFORTUNATELY SOME HAVE MISUNDERSTOOD BOTH THEIR PURPOSE AND THEIR MESSAGE.

THEY DO NOT CONSTITUTE "EXXON'S PLAN," AS SOME HAVE CHARACTERIZED THEM, FOR SOLVING THE COUNTRY'S ENERGY PROBLEM. NOR DO THEY OUTLINE A MAJOR PROJECT UPON WHICH EXXON IS EMBARKED. THEY ARE, QUITE SIMPLY, OUR ASSESSMENT OF THE EXTENT OF THIS COUNTRY'S FUTURE ENERGY NEEDS AND WHAT WE BELIEVE IS POSSIBLE SHOULD THE COUNTRY CHOOSE TO TAKE ADVANTAGE OF ITS TREMENDOUS POTENTIAL FOR SYNTHETIC FUELS.

THE ENERGY TRANSITION

THE UNITED STATES AND THE WORLD ARE IN THE EARLY STAGES OF AN INEVITABLE ENERGY TRANSITION FROM A PRIMARILY PETROLEUM-DEPENDENT ECONOMY TO AN ENERGY-DIVERSIFIED ONE WHICH WILL EVENTUALLY BE MORE RELIANT ON NONDEPLETING FUEL SOURCES.

ALTHOUGH THERE ARE MANY UNKNOWNS ABOUT HOW THIS ENERGY TRANSITION IS GOING TO UNFOLD, THERE ARE SOME IMPORTANT THINGS WE DO KNOW.

- WE KNOW THAT THE TRANSITION FOR OUR COUNTRY ACTUALLY BEGAN SEVERAL YEARS AGO WHEN THE UNITED STATES STARTED TO EXTRACT DOMESTIC PETROLEUM RESERVES FASTER THAN THEY WERE BEING DISCOVERED.
- WE KNOW THAT EVEN THE MAJOR OIL-EXPORTING NATIONS OF THE MIDDLE EAST, WHICH HAVE THE GREATEST KNOWN PETROLEUM RESERVES, WILL BEGIN TO HAVE THEIR OWN PRODUCTION DECLINES WITHIN THE NEXT TWO-THREE DECADES.

AND WE KNOW THAT SOMETIME IN THE NEXT CENTURY, THE WORLD WILL HAVE TO RELY SUBSTANTIALLY ON NONDEPLETING OR RENEWABLE ENERGY SOURCES.

HOWEVER, THE MOST IMPORTANT THINGS ARE THE ONES WE DON'T KNOW. AMONG THE UNKNOWNS IS WHETHER, OR WHEN, WE AS A NATION WILL DEVELOP A CLEAR COMMITMENT TO IMPROVE OUR ENERGY SITUATION. THE 1973-74 ARAB EMBARGO AND THE RECENT IRANIAN SITUATION PROVIDED SHARP AND PAINFUL WARNING SIGNALS. NONETHELESS, OUR COUNTRY CONTINUES TO "MUDDLE ALONG" WITHOUT AGREED OBJECTIVES OR EFFECTIVE ACTIONS TO DEAL WITH OUR ENERGY PROBLEMS. THIS "MUDDLING ALONG" CANNOT CONTINUE WITHOUT SEVERE RISKS TO BOTH OUR ECONOMY AND NATIONAL SECURITY. THERE IS GREAT PUBLIC CONFUSION OVER WHAT THE SOLUTIONS TO THE ENERGY PROBLEMS REALLY ARE. EACH INTEREST GROUP HAS A DIFFERENT FAVORITE--SOLAR POWER, CONSERVATION, COAL, NUCLEAR, MORE CONVENTIONAL OIL AND GAS, SYNTHETICS, OR A COMBINATION OF SEVERAL OR ALL OF THESE.

HEREIN LIES THE BASIC PARADOX IN THE U.S. ENERGY DEBATE. THE FACT THAT THIS NATION DOES POSSESS A VARIETY OF POTENTIALLY LARGE ENERGY SOURCES ACTUALLY HAS THE EFFECT OF CONFUSING THE SITUATION AND MAKING IT DIFFICULT TO SETTLE ON A COURSE OF ACTION.

IN CONSIDERING WHAT ACTIONS WE SHOULD TAKE, IT IS IMPERATIVE THAT WE MAKE THE DISTINCTION BETWEEN ENERGY SOURCES WHICH CAN HELP US NOW, THOSE THAT CAN HELP IN THE DECADES IMMEDIATELY AHEAD, AND THOSE SOURCES WHICH HAVE PROMISE IN THE MORE DISTANT FUTURE.

IN THAT CONTEXT I'D LIKE TO SUMMARIZE SOME OF OUR FINDINGS THAT PROVIDE THE BASIS FOR OUR CONCLUSION ON THE NEED FOR SYNTHETIC FUELS.

U.S. ENERGY OUTLOOK

WE PROJECT THAT EVEN WITH SIGNIFICANT CONSERVATION, THE NATION'S TOTAL DEMAND FOR ENERGY WILL GROW FROM TODAY'S LEVEL OF ABOUT 39 MMB/DOE TO ABOUT 50 MMB/DOE IN 2000. IN THE 1980S AND 1990S, ALL OF THE GROWTH IN DEMAND FOR ENERGY WILL BE SATISFIED BY COAL AND NUCLEAR. IN THE 21ST CENTURY, THE DEMAND FOR ENERGY WILL CONTINUE TO GROW SLOWLY. NONDEPLETING ENERGY SOURCES, SUCH AS SOLAR AND NUCLEAR FUSION, WILL MAKE INCREASINGLY LARGE CONTRIBUTIONS TO THE ENERGY PICTURE AS MORE AND MORE ENERGY IS CONSUMED AS ELECTRICITY. THERE WILL, HOWEVER, BE LARGE SEGMENTS OF DEMAND--PRIMARILY IN THE TRANSPORTATION AND PETROCHEMICAL AREAS--WHICH CAN ONLY BE MET BY LIQUID AND GASEOUS FUELS. MEETING THE DEMAND FOR ENERGY IN THESE FORMS WILL BE OF CRITICAL NATIONAL IMPORTANCE.

WE EXPECT THAT THE DEMAND FOR OIL AND GAS WILL GRADUALLY DECLINE; HOWEVER, THE ABILITY OF THE U.S., AND EVENTUALLY THE WORLD, TO PRODUCE OIL AND GAS FROM CONVENTIONAL SOURCES WILL ALSO DECLINE. TODAY, THE NATION'S DEMAND FOR OIL AND GAS TAKEN TOGETHER IS ABOUT 28 MMB/DOE, OF WHICH ABOUT 20 MMB/DOE IS FROM DOMESTIC PRODUCTION WHILE 8 MMB/DOE IS SUPPLIED BY IMPORTS. BY THE YEAR 2000, WE ESTIMATE DEMAND FOR OIL AND GAS WILL BE ABOUT 25 MMB/DOE, BUT

DOMESTIC PRODUCTION WILL BE ONLY ABOUT 12 MMB/DOE, LEAVING A DIFFERENCE OF 13 MMB/DOE. THIS DIFFERENCE WOULD HAVE TO BE COVERED BY IMPORTS OR BY SYNTHETICS. EARLY IN THE NEXT CENTURY, THE DIFFERENCE BETWEEN THE DEMAND FOR OIL AND GAS AND CONVENTIONAL DOMESTIC SUPPLIES OF PETROLEUM COULD BE ABOUT 15 MMB/DOE AND COULD CONTINUE AT ABOUT THAT LEVEL UNTIL THE MIDDLE OF THE CENTURY. CLEARLY, THESE PROJECTIONS ARE SUBJECT TO VARIATION. THE ESSENTIAL POINT IS THAT FOR MANY DECADES TO COME, THERE WILL BE A LARGE DEMAND FOR ENERGY IN LIQUID AND GASEOUS FORMS WHICH CANNOT BE SATISFIED BY DOMESTIC PRODUCTION OF CONVENTIONAL OIL AND GAS. THIS ADDRESSES THE IMPORTANT POLICY QUESTION OF WHETHER THE VERY LARGE COMMITMENT OF RESOURCES NECESSARY TO DEVELOP A MAJOR SYNFUELS INDUSTRY WOULD BE WORTH IT. CLEARLY WE BELIEVE IT IS.

SYNTHETICS INDUSTRY

HAVING THUS ESTABLISHED A LONG-TERM NEED FOR SYNTHETIC FUELS, WE NEXT ASKED OURSELVES HOW LARGE AN INDUSTRY COULD BE DEVELOPED AND WHAT WOULD BE REQUIRED. TO ADDRESS THAT PROBLEM ONE HAS TO EXAMINE SEVERAL KEY QUESTIONS. FIRST IS THE QUESTION OF RESOURCES. WITHOUT GOING INTO DETAIL, SUFFICE IT TO SAY THE U.S. IS BLESSED WITH ENOUGH COAL AND OIL SHALE TO PRODUCE 15 MMB/DOE OF SYNFUELS FOR 175 YEARS--8 MMB/DOE OF OIL SHALE AND 7 MMB/DOE OF COAL SYNTHETICS.

SECOND, WE EXAMINED SYNTHETIC FUELS TECHNOLOGY. WE FOUND THAT A NUMBER OF PROCESSES ARE NOW READY FOR COMMERCIAL APPLICATION WHILE OTHERS ARE STILL IN THE RESEARCH AND DEVELOPMENT STAGE. SPECIFICALLY WITH REGARD TO OIL SHALE, SEVERAL SURFACE RETORTING PROCESSES HAVE OPERATED SUCCESSFULLY IN LARGE PILOT PLANTS, AND THE TECHNOLOGY NOW IS READY FOR SCALING UP TO COMMERCIAL SIZE. FOLLOWING THE FIRST PIONEER COMMERCIAL SIZE PLANTS, WE CAN EXPECT IMPROVEMENTS IN OPERATING EFFICIENCY AND INVESTMENT ECONOMICS AS THE TECHNOLOGY MATURES. BUT EXPERIENCE IN PETROLEUM REFINING HAS SHOWN THAT THE FIRST GENERATION PLANTS DO NOT BECOME OBSOLETE AS TECHNOLOGY EVOLVES. THUS, GIVEN THE COUNTRY'S OBVIOUS NEED FOR SYNTHETIC FUELS PRODUCTION, WE ANTICIPATE THAT SECOND GENERATION PLANTS WOULD BE IN DESIGN AND EVEN CONSTRUCTION AS THE FIRST ROUND OF PLANTS COMES ONSTREAM. WE SEE LITTLE TO BE GAINED AND MUCH TO BE LOST BY ARBITRARILY DELAYING THAT PROCESS.

THIRD, WE EXAMINED WHETHER ENOUGH CAPITAL COULD BE RAISED TO BUILD A LARGE SYNTHETIC FUELS INDUSTRY. COMMERCIAL SIZE SYNTHETIC FUELS PLANTS WILL BE EXPENSIVE. WE ESTIMATE THAT A TYPICAL 50,000 BARRELS OF OIL PER DAY PLANT WOULD COST $3 TO $4 BILLION "AS SPENT" DOLLARS. THE INVESTMENT REQUIRED TO ATTAIN A PRODUCTION LEVEL OF 15 MMB/DOE IS IMMENSE--OVER $3 TRILLION "AS SPENT" DOLLARS. DESPITE THE MAGNITUDE OF THE INVESTMENTS REQUIRED, WE BELIEVE THEY ARE MANAGEABLE SINCE THEY WOULD BE SPREAD OVER A 30-YEAR PERIOD OR MORE. THE CAPITAL MARKETS HAVE DEMONSTRATED TIME AND AGAIN THAT GIVEN sound investment opportunities, the necessary capital is forthcoming. The annual investment in synthetics during the peak years of construction would represent only about one percent of GNP. Or put in another way, this investment represents a sum about equal to the petroleum industry's typical annual expenditures on exploration and production of conventional oil and gas.

It is important to recognize the time scale for the development of a synthetic fuels industry. The first plants will not come onstream until the mid-1980s. Several studies estimate that the level of synthetic fuels production in 1990 will be about 1.0 MMB/DOE. These estimates seem consistent with reaching or coming close to the national goal of 2 MMB/DOE of synthetic fuel production in 1992 as embodied in the recently passed Energy Security Act.

Looking specifically at shale oil, our scenerio projects a build-up of production to .4 MMB/DOE in 1990, 1.5 MMB/DOE in 1995, about 3.0 MMB/DOE in 2000, and ultimately to 8 MMB/DOE. Our estimate for 1990 is not too different from numbers discussed by others. To our knowledge, few, if any, have really tried to take the problem beyond the 1990 time frame. Admittedly, there are many unknowns about the ultimate levels of shale oil and other synfuels production that can be achieved. We believe it is important, however, that as the nation plans for synthetic fuels development, we do so in a way that does not preclude achieving our full potential, whatever it may be.

IN OUR STUDIES, WE HAVE LOOKED AT MANY PARAMETERS THAT WILL INFLUENCE THE ULTIMATE SHAPE AND SIZE OF A U.S. SYNFUELS INDUSTRY. WE BELIEVE THE ONES I HAVE ALREADY MENTIONED WILL NOT BE LIMITING--TECHNOLOGY, THE BASIC RESOURCES, AND CAPITAL AVAILABILITY. I MUST HASTEN TO ADD, HOWEVER, THAT IN THE CASE OF THE LATTER TWO, GOVERNMENT POLICY COULD ACT AS A LIMITATION.

FOR OTHER PARAMETERS, WE BELIEVE THAT REALIZING TIMELY DEVELOPMENT OF OUR FULL SYNFUELS POTENTIAL REQUIRES A COORDINATED EFFORT OF THE PRIVATE SECTOR AND GOVERNMENT AT THE LOCAL, STATE, AND NATIONAL LEVELS. IT IS NOT AN OVERSTATEMENT TO SAY THAT IT WILL, IN FACT, REQUIRE A COMMITMENT OF A MAGNITUDE NEVER ACHIEVED IN PEACETIME IN THE HISTORY OF OUR COUNTRY. FORTUNATELY, IF WE GET ON WITH IT, THERE IS STILL TIME.

FOUR EXAMPLES INVOLVING OIL SHALE--BUT WHICH HAVE COUNTERPARTS FOR WESTERN COAL-BASED SYNFUELS AS WELL--WILL SERVE TO ILLUSTRATE MY POINT.

- FIRST, THE NEED FOR WATER. SEVERAL STUDIES, INCLUDING OUR OWN, SUGGEST THAT WATER FROM LOCAL SOURCES WOULD PERMIT CONTINUOUS DEVELOPMENT OF A SHALE OIL INDUSTRY THROUGH THE LATE 1990'S UP TO A LEVEL OF 1.5-2.0 MM/BD. BEYOND THAT LEVEL, INTERBASIN WATER TRANSFERS WOULD BE REQUIRED. THESE APPEAR TO BE PHYSICALLY FEASIBLE. THE BASE LOAD COST OF INTERBASIN WATER TRANSFER WOULD REPRESENT A VERY SMALL PERCENT OF THE

COST OF SYNFUELS AND COULD BE BORNE BY THE SYNTHETICS INDUSTRY. THIS WOULD, IN FACT, MAKE IT POSSIBLE TO SIZE THE FACILITIES TO BRING IN INCREMENTAL WATER FOR AGRICULTURAL, MUNICIPAL, AND OTHER USES ON ATTRACTIVE TERMS.

FEW SUBJECTS ARE OF GREATER CONCERN IN THE WEST THAN WATER. INTERBASIN TRANSFERS ARE NOT NEW BUT HAVE ALWAYS COME ONLY AFTER LONG DEBATE AND EFFORT. TO DEVELOP SUCH A PROJECT FOR SYNTHETIC FUELS WILL REQUIRE THE INVOLVEMENT AND ACTIVE PARTICIPATION OF ALL THE AFFECTED STATES IN THE REGION AS WELL AS THE FEDERAL GOVERNMENT. THE LATE 90'S TIME HORIZON OF NEED MAKES THIS SEEM DOABLE IF WE START NOW. THE CHALLENGE AT THIS TIME IS TO CREATE THE ACTION ~~ACTIVE~~ GROUPS TO DEVELOP PLANS, NOT FURTHER STUDIES TO DEFINE CONSTRAINTS.

- SECOND ARE THE ISSUES OF INFRASTRUCTURE AND SOCIAL IMPACT. WE APPLAUD THE SENATOR'S EFFORT ON COMMUNITY IMPACT ASSISTANCE LEGISLATION. WE WOULD BE PLEASED TO WORK WITH YOU TO OBTAIN THE NEEDED LEGISLATION. I MUST HASTEN TO ADD, HOWEVER, THAT IN LIGHT OF THE POTENTIALLY LARGE GROWTH OF THE INDUSTRY OVER THE COMING DECADES, EVEN MORE ASSISTANCE FOR THE AFFECTED COMMUNITIES WILL BE NEEDED THAN IS PROPOSED IN YOUR LEGISLATION OR IS CONTAINED IN OTHER EXISTING PROGRAMS.

I BELIEVE MANY COMPANIES INVOLVED IN SYNFUELS ARE SENSITIVE TO AND RECOGNIZE A REPONSIBILITY TO HELP MITIGATE THESE SOCIO-ECONOMIC IMPACTS. CERTAINLY, EXXON DOES. PLANNING FOR THESE IMPACTS AND THE CREATION OF THE REQUIRED INFRASTRUCTURE MUST INVOLVE MANY CONSTITUENCIES: THE PRODUCING COMPANIES, PEOPLE AT THE LOCAL LEVEL DIRECTLY AFFECTED, EXISTING BUSINESS AND CIVIC GROUPS, GOVERNMENTS AT LOCAL AND STATE LEVELS, ACADEMIC AND OTHER INSTITUTIONS. IT LIKELY WILL BE NECESSARY TO CREATE SOME NEW ENTITIES TO COALESCE THESE INTEREST GROUPS INTO A RESULTS-ORIENTED EFFORT IF WE ARE TO EFFECTIVELY DEAL WITH THE MANY ASPECTS OF THE PROBLEM. NOT THE LEAST OF THESE PROBLEMS IS ADEQUATE FRONT-END FUNDING.

- THIRD, THE ENVIRONMENTAL ISSUES MUST BE ADDRESSED IN FURTHER DETAIL. ALTHOUGH WE HAVE DONE SOME WORK, WE HAVE NOT UNDERTAKEN FULLY DETAILED STUDIES NEEDED TO ASSESS THE IMPACTS OF A LARGE-SCALE INDUSTRY. BASELINE STUDIES AND RELATED ENVIRONMENTAL IMPACT WORK SHOULD BEGIN NOW FOR A LARGE OIL SHALE INDUSTRY. IF, IN FACT, A MULTI-MILLION BARREL OIL SHALE INDUSTRY IS TO DEVELOP, THE ENVIRONMENTAL EFFECTS CANNOT LOGICALLY BE ASSESSED BY EXTRAPOLATING MODELS CREATED TO STUDY THE FIRST ONE OR TWO PLANTS TO EVALUATE THE IMPACT OF A MATURE INDUSTRY DEVELOPED OVER THIRTY YEARS. AS HAS HAPPENED IN OTHER INDUSTRIES, ONE WOULD LOGICALLY EXPECT CONTROL TECHNOLOGY FOR OIL SHALE TO MATURE WITH THE INDUSTRY.

Some modifications may be necessary in the Clean Air Act. But we believe that a sizable industry can be developed which would not violate fundamental health and safety standards and which would meet the expections of reasonable people.

- Finally, the Federal leasing program for the Piceance Basin must be geared to whatever long-term expectations the nation finally sets for an oil shale industry. A piecemeal approach will not suffice. Along this line, we commend the Department of the Interior for their recent initiative to expand the prototype oil shale leasing program and to structure a permanent leasing system. For the oil shale industry to develop consistent with the scenario I have presented, the permanent leasing program must be put in place within the next two or three years and must include leases in the appropriate areas of the Basin to accommodate large-scale surface mining. We support the Department of the Interior's initiative to remove the maximum Federal lease holding limitation of 5,120 acres by one company, and to allow off-lease disposal of spent shale and off-lease siting of processing facilities.

In conclusion, the U.S. clearly has the potential for a major synfuels industry. The degree to which we realize that potential will depend on many decisions by many people--in and out of government--and in and out of Colorado.

THE COUNTRY'S POTENTIAL CAN BE ACHIEVED, WE BELIEVE, IN WAYS THAT ARE SOCIALLY, ENVIRONMENTALLY, AND POLITICALLY ACCEPTABLE. THE FIRST STEP IN THE PROCESS IS TO EXPAND THE PUBLIC DISCUSSION--INVOLVING THOSE WHO WILL BE DIRECTLY AFFECTED--BE THEY CITIZENS IN THE AREAS OF POTENTIAL SYNFUELS PRODUCTION OR THAT BROADER GROUP OF CITIZENS WHO ARE AFFECTED BY THE IMPACT OF THE DRAIN ON OUR ECONOMY OF EXCESSIVE FOREIGN OIL IMPORTS OR WOULD BE AFFECTED SHOULD THOSE FOREIGN IMPORTS BE CUT OFF.

WE VIEW THESE HEARINGS AS A PART OF THAT PROCESS AND COMMEND YOU FOR HAVING THEM AND PARTICULARLY FOR HAVING THEM IN COLORADO, WHICH IS DESTINED TO PLAY SUCH A KEY ROLE IN THE NATION'S ENERGY FUTURE.

I WOULD NOW BE HAPPY TO ANSWER ANY QUESTIONS YOU MIGHT HAVE.

Senator HART. We will have a panel of witnesses now composed of individuals representing the Colorado Department of Natural Resources, Monte ascoe, and representing the Environmental Protection Agency, Mr. Terry Thoem.

Gentlemen, welcome. We have gotten ourselves, unfortunately, in a little bit of a time bind. I appreciate both your presence here. I will urge you to any degree possible to summarize your comments about the entire subject matter that we're investigating here today and particularly the proposal which you have just heard. Then perhaps we'll have a little time for both questions and two more witnesses.

Our next witness will be Mr. Monte Pascoe, executive director, Colorado Department of Natural Resources.

STATEMENT OF D. MONTE PASCOE, EXECUTIVE DIRECTOR, COLORADO DEPARTMENT OF NATURAL RESOURCES

Mr. PASCOE. Thank you, Senator Hart. I will speak a little bit about the State's anticipated plans that relate directly to the issue of how much oil shale should be produced or oil should be produced from oil shale.

Senator HART. Excuse me 1 second. We're going to produce a lot of synthetic fuels in this country. What we can't produce is a sound system that works. So, for the benefit of those behind you, I would urge you to speak up a little louder.

COLORADO OIL SHALE INDUSTRY LIKELY

Mr. PASCOE. It does appear now that after more than 60 years of speculation and demonstration projects, Colorado is likely to have an oil shale industry in its northwestern counties. A former colleague of mine, now over 90 years old, who began his career about the time that oil shale reached its first of many zeniths, assures me that I don't have to worry about this. But I do believe that Colorado now has to worry about it, that it will not pass.

At the outset and for some time to come, as we have already heard, it is also likely that somewhat traditional mining and processing techniques will be used, room and pillar and open-pit mines with adjoining surface retorts. Until early this year, the State's best estimates were that, at most, 250,000 to 350,000 barrels of oil would be produced daily by 1990 in Colorado from oil shale using a variety of technologies, not just those that I've mentioned.

REVISION OF OIL SHALE ENERGY PRODUCTION PROJECTIONS NECESSITATED BY MIDEAST CRISIS

Our studies of economic and environmental impacts were based on these assumptions which were considered the worst case or the highest energy production projections. For several months, it has been apparent that these projections were low and that the State's highest oil shale energy production projections or worst-case projections must be revised upward to from 500,000 to 700,000 barrels a day of oil by 1990.

These revisions were required in part because of the continuing political instability in the Middle East. They were also required perhaps in even larger part by the increased availability of funds from the Federal Government. I want to emphasize that for a moment.

As this committee knows, millions of dollars have been spent on research, demonstration, and development assistance for those in industry who had an interest in oil shale. The increased availability of funds in a variety of forms including substantial additional tax benefits has made it apparent even more companies will be joining the parade to oil shale forcing use of the more traditional although possibly less environmentally sound technologies in order to be among the first in production.

In short, the current spurt of activity resulting in the need for Colorado to revise its projected oil shale production figure upward is federally driven. No one should believe that shale production is free enterprise at work. In fact, it would be useful for the committee to determine the amount of Federal funds spent on oil shale activities, then determine how much of that amount was primarily for assisting industry with its technology and how much was for State and local government to cope with industry's impacts.

INCREASE FEDERAL ASSISTANCE TO STATE AND LOCAL GOVERNMENTS

I believe this analysis will show that the Federal Government is the driving force, and it will also show why State and local governments are struggling so in their effort to be prepared for oil shale impacts and to keep up with Federal and industry initiatives. The Federal Government must provide more assistance to State and local governments or even the levels of production to be discussed are not attainable.

I want to emphasize to the committee that this State is going to be very protective of its resources. At the same time, it will be very cooperative with a reasonable industry being put in place in northwestern Colorado. But even if we are struggling against massive Federal assistance through synthetic fuels aid and through tax advantages, we are not going to drop out of this race. But I do want the committee to know that it is very difficult to stay even when you have all of those resources being used to develop initiatives, and the impacts have to be handled by a relatively few people.

IMPACT OF FEDERAL ASSISTANCE ON RESOURCES DEVELOPMENT

Senator HART. Could I just ask kind of a philosophical question, because this is part of the puzzle I think a lot of people feel. The industry is, I think, adequately represented by Mr. Slick. Although he didn't take off on his tangent too much this morning, he has generally said that the reason resources aren't developed in this country is because of the Federal Government.

Now, you, as a very knowledgeable and I think reputable spokesman for the State of Colorado, are saying just the opposite. How can that be? Industry is saying the Federal Government is blocking it and the State of Colorado is saying the Federal Government is running a steamroller over it.

Mr. PASCOE. I, frankly, think that the State of Colorado would have a very modest oil shale development if the billions of dollars that had to be spent were going to be spent out of the treasuries of the companies that had to spend them and not with Federal assistance either through unusual tax advantages or through direct subsidies in the form of purchase agreements or loan guarantees or something else.

And I just happen to think that they would have spent this money with the same caution that they spent it on oil shale over the last 60 years if the Federal Government had not announced it was stepping in in a big way. In many respects I regret the Federal Government made that announcement, because I think this is the industry, frankly, that least needs to be subsidized in this country. If we're going to solve our energy problem, my inclinations, as I will mention later, is that we can have development and research funds better directed to other industries. But it seems to me this one is most able to take care of itself. I think that may be a fundamental problem we may have to deal with in the next few years.

HUMAN SERVICES FACILITIES

Our projections show that when coupled with other energy development in northwestern Colorado, more than $1 billion must be spent by 1990 on facilities such as schools, parks, health facilities, police and fire protection, and other human services to meet necessary and traditional public needs for the now dated high production activities of 350,000 barrels a day. This number of $1 billion does not include public utilities and transportation and other facilities that will be required to take care of the industry's needs. The number does anticipate population increases in Rio Blanco County of from 5,300 to 24,000 over this 10-year period and Garfield County from 20,000 to 81,000 over the same period along with substantial increases in adjoining counties of Mesa and Moffat.

If all technologies used were to be open pit or room and pillar mining with surface retorts rather than a variety of technologies that have been the purpose of the prototype leases, these projected increases in population would probably be even greater. If daily production should increase to 500,000, 600,000 or 700,000 barrels a day in Colorado by 1990, the impacts would be staggering and, if quality of life has any meaning at all, unmanageable. We simply cannot put that much of a structure together for people to have a decent life if there's that much production in the next 10 years.

Senator HART. I'm sorry. How much production?

Mr. PASCOE. If there is production in the range of 500,000 to 700,000 barrels, which is what some of the industry and Federal Government estimates now are, we simply don't have the front-end money and capability for doing it.

PROBABLE PRODUCTION OF OIL SHALE INDUSTRY

Senator HART. Most Federal estimates present in Congress are in the 400,000-barrel-a-day range. You mention the word "reasonable," a reasonable size oil shale industry. What range are you talking about?

Mr. PASCOE. The 400,000-barrel-a-day range is an old number. It is a number that's still being used publicly because it hasn't been officially changed. But the kinds of estimates we get now from the industry show that in Colorado alone we're something around 500,000, 600,000 or 700,000 barrels per day by 1990 depending on how fast some of the proposals come on stream.

Senator HART. What you're saying is since the Government enacted the subsidies, it has in effect lost control of the total capacity.

Mr. PASCOE. It hasn't lost control of it yet. But if it begins to pump the money out the way that it has been suggested it will pump it out, it will lose control. And we hope very much that the Government will stage its use of these funds in such a way that it will maintain reasonable production, rather than allowing the industry to go ahead faster than had been anticipated before.

Senator HART. Is 400,000 barrels a day reasonable?

Mr. PASCOE. 400,000 barrels a day is a number that was used for total production in Utah and Colorado. It has been our estimate that the Colorado portion of that would be 250,000 to 350,000 barrels a day. And our planning had been based upon that, and we thought and we do think that it's possible to do it. As a matter of fact, I have here just another sentence that relates directly to that question. And I say that it is possible and, through hard work and luck, even probable that with enough front-end capital and careful planning, acceptable living conditions can be available by 1990 to accommodate even a modest increase over the numbers of persons we would expect to have been there if the production had been 350,000 barrels a day. That will not be easy, and all will have to go well including close continuing cooperation and assistance from the Federal Government and from industry.

I want to turn now if I can to the natural resources and environmental conditions that will both support and limit oil shale production. These natural conditions are important and even controlling. I want to make this point though. From the standpoint of the State of Colorado, for the levels of production that we now anticipate, even the very highest projections by 1990, the natural and environmental conditions are not as important as the conditions under which we require people associated with this industry to live. And how we plan for people and what they need to live a decent life could affect whether we even have the capability of producing 350,000 barrels a day by 1990.

Studies have estimated without seriously damaging agriculture, recreation, and other existing industries and without considering water quality issues on the Colorado River, water for the production of about 500,000 to 700,000 barrels a day is available. This study is not site specific, and the water may have to be conveyed some substantial distances, modest compared with the proposal we just heard but still substantial distances. And both factors may actually reduce the usable water for oil shale. The difficulty here is that an enormous amount of the production may be in the White River, and the supplies of water in the White River are relatively limited compared with some of the other river systems.

EXISTING WATER RESOURCES INADEQUATE FOR LARGE SYNFUEL INDUSTRY

Senator HART. Mr. Pascoe, you're well known and rightly so as a water expert. And I think that's one of the reasons you're in the position you're in now. Do you agree or disagree with Exxon's contention that there is sufficient water in existing basins and streams in this State to accommodate an industry of 1½ to 2 million barrels a day?

Mr. PASCOE. In my judgment there's not sufficient water unless we get the lower basin States to give us back some of the water that's committed by compact and unless we take water away from other very valuable industries and very valuable uses in western Colorado.

Senator HART. Is the figures you're using, I think 500,000 to 700,000 barrels a day, a maximum figure?

Mr. PASCOE. That's a maximum figure based on a study that was done by the State of Colorado for the Water Resources Council. These are gross numbers. They make an enormous number of assumptions about issues like water quality which is one major problem on the Colorado River. But it's the best we have right now. It's a starting point for more refined studies.

Senator HART. But as an acknowledged water expert and spokesman for the State in this matter, you're off from Exxon's estimate by a factor of about 100 percent.

Mr. PASCOE. I know. I've also had a very substantial experience with transmountain diversions. And I can assure you most people in the Mississippi River basin will consider, think, their water more important than oil shale. It's the same position every river basin has taken in this country. So I don't look upon that as an easy or likely prospect for water resources. We also have other great demands in the Missouri River basin for some of that water if it were in fact available such as the high plains of Colorado and other States who are desparately in need of water resources to maintain their irrigated economy.

KNOWLEDGE OF SURFACE AND GROUND WATER QUALITY INADEQUATE

The second thing I'd like to call to the attention of the committee is we know very little about impacts of oil shale production on surface and ground water quality. This lack of knowledge may until more research can be done require that the State move slowly in granting permits for activities that are likely to jeopardize water quality. We are quite concerned about it.

The air quality issue I'm sure will be discussed later. But it, I believe, constitutes a limit also on oil shale development unless we accept air quality far below what the people of this State and country have come to expect and rely on.

UNBEARABLE LIVING CONDITIONS WOULD RESULT FROM FISCALLY UNSOUND SYNFUELS POLICY

The fact is—and I think this is something I'd like to emphasize—the projected production per day by 1990 of 500,000 to 700,000 barrels may in fact be a very large percentage of the daily production of oil shale or oil from oil shale in Colorado that can be reasonably expected, not just by 1990 but at some later period of time, because those production levels will be reaching some of the limits that we're talking about here on water supply, air quality, water quality, and other questions of substantial importance.

PHYSICAL LIMITATIONS

Only so much capital is available. Only so many construction workers are available. Only so many concrete trucks can travel over these roads before we have accomplished the unenviable result of having made living in Rio Blanco and Garfield Counties unbearable and at the same time made it almost impossible for oil shale to materially assist this country in meeting its energy needs.

After 1990 projections are reached and given the limits just discussed, increased production of oil from oil shale will probably be measured in tens of thousands of barrels rather than in millions of barrels. It is important that Congress, the executive branch, and the country recognize this reality. To ignore it may only result in placing all our treasure in the ground of northwestern Colorado with no practical way to get it out.

A fiscally sound synfuels policy will recognize this. The free enterprise system recognizes it. The Federal Government must recognize it. If we dream of a few square miles in the corner of Colorado as our new Persian Gulf, the mistake could be fatal. If weaning ourselves from dependence on foreign oil is limited to digging huge pits, conveying water hundreds of miles, vastly overburdening our physical and people resources, all at the risk of draining our national capital, we are skating on very dangerous ice.

The National Academy of Science reports that 20 powerplants the size of the Public Service Pawnee powerplant would be required to meet the energy needs of a 6 million-barrel-a-day industry. The Public Service Co. in Colorado informs us they're having a very difficult time obtaining sufficient capital to build one powerplant, let alone trying to build 20 or 26 which would be required for a 6 to 8 million-barrel-a-day industry.

An 8 million-barrel-a-day industry in approximately 14 days would remove enough material from open pits to fill the Panama Canal. We can do better than this in this country, and we should. Oil shale with Federal, State, and industry cooperation will help this country achieve energy independence. However, we must not overestimate the help we can expect from oil shale, and we must direct substantial effort toward conservation, other synfuels, solar, and other alternate energy sources and to whatever else our creative citizens can discover and implement. If that is done, I think the State of Colorado will help very materially but not to the extent of the numbers that we have been hearing. Thank you very much.

Senator HART. Thank you, Mr. Pascoe. An excellent statement.

Mr. Thoem?

STATEMENT OF TERRY L. THOEM, DIRECTOR, ENERGY POLICY COORDINATION OFFICE, ENVIRONMENTAL PROTECTION AGENCY, REGION VIII

Mr. THOEM. Thank you, Senator Hart. It's a pleasure to be here and provide EPA's testimony into this hearing.

EPA has since we were created advocated that some level of oil shale development occur out in western Colorado, and we feel that there's a lot of merit to that orderly phase sort of development. I spell out in my testimony what we think those advantages are.

Senator HART. Excuse me one second. I will instruct you to have that observation in your prepared statement. It leaped off the page at me in this respect: I was not aware that EPA was an advocacy agency. In other words, I did not know that EPA even up to 2 years ago in the present proposed synthetic fuels industry was in the business of advocating types of energy development. Do you really mean to say that?

Mr. THOEM. What I mean is that we have indicated that we felt some level of module plants and some types of facilities be constructed in the Piceance Basin so we could make the measurements of air emissions and make the measurements of water quality so we could truly define what the environmental impacts were, advocating from that approach as opposed to saying let's don't do anything and then immediately go to an 8-million-barrel-a-day industry. So that's the advocacy role.

Senator HART. Thank you.

AIR QUALITY ISSUES RELATED TO 8-MILLION-BARREL-A-DAY INDUSTRY

Mr. THOEM. Several events in the recent past have threatened this orderly face approach that we feel is prudent, one of which we feel is the Exxon suggestion that 8 million-barrels-a-day in the Piceance Basin would be a manageable task. The testimony that I provide today centers on air quality issues related to that 8-million-barrel-a-day industry.

I'd like to turn your attention to the chart that I have here that's also reproduced as figure 1 attached to the testimony.[1] It is a representation of oil shale country, and the oil shale sites that were listed there were the subject of an air quality modeling effort. That total number of oil shale sites adds up to about 100,000 barrels-a-day. We extrapolated the inclusions that I'll show on the overlay from that modeling effort. This first overlay—and I again should emphasize that this is an 8-million-barrel-a-day case.

Senator HART. Eight million or 800,000?

VIOLATIONS OF AIR QUALITY STANDARDS

Mr. THOEM. Eight million. This is extrapolating to an 8-million-barrel-a-day industry. The yellow areas on that map show the geographical extent of the primary air quality standard, the health standard violations. We predict that there will be violations of particulate matter, of ozone, of SO_2 and possibly the short-term NO_x standard that we're considering.

The second overlay shows the geographical extent of that NO_2 violation. It covers the total Piceance basin and Uintah basin.

OZONE STANDARDS

The next figure shows that ozone standards would be violated throughout the entire Piceance basin and Uintah basin which shows the distance out to at least 800 kilometers, getting out toward

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[1] See p. 55.

Steamboat Springs, Vail, Aspen areas, including all of the class 1 areas on the western slope of Colorado. The reason it doesn't go further is that's as far as we could extend our modeling capabilities and concentrations would still remain fairly constant.

Senator HART. Two questions. For the layman, Mr. Slick said that he didn't think we should change our primary health standards for the primary laws, but some secondary standards would have to be changed. Are the charts you're showing us there primary or secondary standards?

Mr. THOEM. These are the primary standards, the health standards. And we would predict that there would be violations of all four of those pollutants.

Senator HART. By a factor of what?

Mr. THOEM. The ozone standard is just vastly exceeded. We got close to the standard with 800,000-barrel-a-day case, about 220 micrograms compared to 240. So it would be enormously exceeded.

Senator HART. Possibly by a factor of 10?

Mr. THOEM. Perhaps.

Senator HART. So he's saying we should not change the primary public health standards to accommodate an 8-million-barrel-a-day oil shale industry, and you're saying we would begin to surpass them at 100,000 barrels-a-day and would violate them by perhaps a factor of 10 at 8 million?

Mr. THOEM. That's right, specifically for ozone. For the nitrogen oxides and particulate matter, there would be different levels.

Senator HART. He says this gross disparity will be accommodated by improved modeling. Do you agree with that? In other words, we're using crude tools. When we sharpen the tools, we can account for this.

Mr. THOEM. There's certainly opportunity for some improvements in modeling. Most of the validation studies that have been performed at sites end up confirming that modeling pretty well. So while you might expect future modeling efforts to allow that lid to go a little bit higher, I don't think you're going to see it go drastically higher.

IMPACT OF RELATED ACTIVITIES ON AIR QUALITY STANDARDS

Senator HART. Did this data include supporting and related activities, or is this just the industry itself? In other words, does that include the 1.5 million people and additional powerplants and all the rest?

Mr. THOEM. That's a point that I'd certainly like to emphasize. It only includes the facilities themselves, the oil shale facilities. And because of the modeling technique that we use for this study, the particulate and sulfur dioxide concentrations we know are underestimated. We used a modeling case that allows for good dispersion of those pollutants.

Senator HART. So you were conservative?

Mr. THOEM. Very, very conservative. The valleys over there are subject to oftentimes inversion conditions that are going to trap those pollutants down in the valleys. We did not model that case. We didn't include the emissions from the 1.5 or 1.7 million people in that estimate.

I might also indicate that another thing we did not include in that estimate was any emissions that would result from surface mining. This assumes underground room and pillar mining.

PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

The second aspect of the ambient air quality standards that has been discussed earlier besides the health-related standards is the concept of prevention of significant deterioration. The national parks and wilderness areas shown on that map have been designated by Congress for special protection. And we, through our extrapolation, would predict that the class 1 increments would be violated at most of those class 1 areas as a result of an 8-million-barrel-a-day industry.

We would further predict that the class 2 increments that are established for the rest of the parts for western Colorado would be violated easily out to about 50 kilometers from a development area. And again, we would expect that that would go out even further as a result of a better modeling case, one that didn't allow as good a dispersion. The modeling attempts that have been made to try to predict concentration are filled with some uncertainties. But I think that a proper perspective of what air quality might result out of western Colorado could be obtained by comparing emissions from an 8-million-barrel-a-day industry with the emissions from some other areas that we know what the air quality is like. And I include as table 2[1] in the testimony that comparison to a number of areas.

EMISSIONS DENSITY

Some of the more graphic I would like to point out. Emissions from an 8-million-barrel-a-day industry for particulate matter would be something like two times the entire New York-New Jersey-Connecticut air quality region.

Senator HART. Say that again.

Mr. THOEM. The emissions density from an 8-million-barrel-a-day industry would be more than twice the total of New York-New Jersey-Connecticut air qaulity control region. It would be more than 15 times Denver's emissions. It would be 2½ times the entire emissions density running from New York City down to Washington, D.C.

Senator HART. It would be 15 times what it is in Denver now?

Mr. THOEM. That's right. That's correct. For nitrogen oxides, there are similar comparisons, 15 times Denver's nitrogen oxides emissions. For sulfur dioxides, it would be eight times the level of Denver. And it would be essentially equal to the entire New York City to Washington, D.C., coastline.

I think an additional perspective can be gained by comparing the particulate emissions from this 8-million-barrel-a-day industry to the emission from——

Senator HART. Excuse me one second. I heard Elmer "Sumat", industry people, and others about how the clean air laws, both Federal and State level, have hampered industrial development because of the inability to calculate so-called fugitive gas or background particulates, whatever, that people have been breathing forever before there was industry. And this is one of the more idiotic characteristics of the Federal program and so on. Do your numbers include or exclude that background particulate business?

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[1] See p. 60.

Mr. THOEM. They would only include the finest particulate emissions that would be coming from the process.

Senator HART. But not dust?

Mr. THOEM. Not dust. Not any of the large particles.

Senator HART. Thank you.

Mr. THOEM. I started to mention that another prospective of the amount of particulate emissions come from an 8-million-barrel-a-day industry, you could compare that to the emissions from all coal-fired powerplants projected to be constructed between now and the year 2000. And that emissions number is essentially equal. That suggests that building all coal-fired powerplants in the United States between now and year 2000, putting them in that area, you'd have the same amount of emissions.

IMPACT OF INDUSTRIAL EMISSIONS ON VISIBILITY

I think a further perspective can be obtained on air quality impacts by trying to associate the emissions and their impact on visibility. I have a couple of slides that I would like to show.

Again, this is to try and show some perspective. This is a view from the Dinosaur National Monument looking over toward C-a and C-b tracks over Cathedral Bluffs.

Senator HART. So that's west to east?

Mr. THOEM. That's looking from west to east. The mountain range right in there is Cathedral Bluffs. That would represent a clear day of about 150 to 180 miles visibility.

We tried to pick the dirtiest possible that we could find that we could measure, and this is what it would look like. The results of an 8-million-barrel-a-day industry would be roughly three to four times worse than that. And this would occur on a very frequent basis.

Another view, looking from Dinosaur National Monument down into Utah, south-southwest, the view in the foreground is the "Book" Cliffs about 90 kilometers away. The view in the foreground is about 20 to 30 kilometers away. Again, we tried to find the worst possible day we had photographed. You see that you've lost that distant "Book" Cliff's view, and you're only left with this foreground view, the 20 to 30 kilometers.

DENVER AIR QUALITY

Senator HART. What are the prevailing wind patterns in northwest Colorado? Is it roughly east to southeast ranging toward the Denver area or what?

Mr. THOEM. Principally from the west to east with southwesterly components.

Senator HART. Do you agree or disagree with Mr. Slick's interpretation that even the maximum synthetic fuels industry which he projected would in no case affect Denver air quality?

Mr. THOEM. To try to estimate what the impact on Denver, of course, starts stressing models. But I think we could probably draw upon again some of the emissions density comparisons and some of the situations that we know exist in the east coast. And certainly, there's more and more evidence to cite that some of the air quality degradation is a result of long-distance transport. Some studies from St. Louis have shown—have tracked a plume in fact as far as 300 miles.

Comparing the emissions from the 8-million-barrel-a-day industry with some of the emissions in the east coast, I'd have to say that it could be likely that you'd get that transport over into the Denver area. And the quantity is unknown, but I don't think you could say out of hand that we would not see some of those emissions over in Denver.

Just to complete the thought on visibility, we have done calculations on what the impact across the basin would be and calculate that the visibility would be reduced to less than 12 miles.

WATER QUANTITY AND QUALITY

Turning attention to water quantity and quality, I think this discussion has gone on pretty adequately already. But I would just point out that if that amount of water to supply an 8-million-barrel-a-day industry was to all come from the Colorado River basin, it has an obvious impact on salinity. And we calculate salinity concentrations could increase as much as 80 milligrams per liter. You can associate cost to downstream users with that increase in salinity and come up with numbers like $30 million a year to downstream users.

The mention was made of a need for a 3,000-megawatt powerplant to pump water. It would in fact, according to our calculations, take 150,000 barrel a day of shale oil to supply the power for those pumps, so it does mean three plants.

Senator HART. Did you do any calculations about the net energy return from oil shale; that is to say, the power required, the energy required to run the industry at the level Exxon's proposing?

Mr. THOEM. No; we didn't do any of those.

Senator HART. Just the water?

Mr. THOEM. Yes, that's right. Of course, additional reservoir capacity would be needed to supply that water. And it could be estimated that as much as 3 million acre-feet of storage capacity would be needed. I pointed out that that's three times the size of the three Gunnison River reservoirs of Blue Mesa, Morrow's Point, and Crystal.

Again, comparing the water consumption from the 8-million-barrel-a-day industry to a projected powerplant capacity, it's about half, half of the powerplant capacity conducted between 1980 and 2000, the same amount of water used as with an 8-million-barrel-a-day industry.

The water numbers that we have looked at, again, do not include those associated people impacts. The 1.5 million as Mr. Pascoe has pointed out, that does mean, translate into community service needs, the calculation for cost of waste water treatment plants alone is about $500 million.

SOLIDS HANDLING

Turning to the solids handling, there will be hazardous waste and solid waste generated by an oil shade industry. The acreage that would be required for spent shale disposal from this 8-million-barrel-a-day industry would be a nearly 3,000-acre pile as tall as the Anaconda Tower Building.

The logistics of mining the necessary shale are staggering. As you appropriately pointed out, the amount of material that would have to be mined is almost five times the total capacity in the United States. And the sheer logistics of putting the equipment and that labor force into western Colorado is just staggering. If open pit mining were used, I think another perspective could be gained. I think most people are familiar with the large, open pit copper mine being the Canyon Mine over near Salt Lake City. It would take about 80 of those to supply the needs of an 8-million-barrel-a-day industry.

I won't touch on the people aspects. Again, I think that has been adequately addressed, and I do refer you just to my comments in the testimony.

I'd like to conclude by suggesting that there are numerous unanswered questions associated with oil shale development. We feel that there is little quantitative data that can accurately describe what the air emissions, what the water effluents, and solid waste might be from that industry. We don't think, after comparisons between mining technologies and retorting technologies, it is possible at this time. It's our opinion that answers to these broad questions and many other specific questions should be obtained while oil shale development proceeds to some modest, reasonable level.

Senator HART. Do you have any estimates as to what that should be?

Mr. THOEM. We're comfortable with the suggestion of the 400,000-barrel-a-day estimate that Congress and the President has put forth. Our air quality modeling shows that would be probably accommodated. We think that as long as you proceed toward that 40,000 barrels a day in a reasonable manner, seasonable time frame, and not do it tomorrow, that that would be a reasonable goal.

I think I'll just close with that comment and be glad to answer any questions you might have. Thank you.

Senator HART. Thank you and Mr. Pascoe for excellent statements.

PREPARED STATEMENT OF TERRY L. THOEM, DIRECTOR, ENERGY POLICY COORDINATION OFFICE, ENVIRONMENTAL PROTECTION AGENCY, REGION VIII

It is my pleasure to provide EPA's input to this hearing on the pace and ultimate level of oil shale development in Western Colorado and Northeastern Utah. EPA has since we were created ten years ago advocated that some limited development of oil shale proceed. We still maintain the philosophy that a mix of technologies should be investigated in order to determine the optimal mix for an industry. The Prototype Oil Shale Leasing Program was and remains to be a good framework for the industry, government and the public to evaluate the positive and negative aspects of the development of oil shale. Advantages to an orderly development approach accrue to all sectors. Industry can iron out technological flaws at an early stage and can better design commercial facilities. Industry and the financial community can better define the capital and operating costs associated with oil shale production. Industry, regulatory agencies, and environmental organizations can more accurately quantify waste streams and their impacts on the environment.

Recent events threaten this orderly approach. The ever-growing burden of our oil imports price tag, the Exxon study which concluded that 8 million BPD was manageable, a Lawrence Livermore Lab. study investigating a 5 million BPD operation, and the DOI decision to proceed toward the design of a permanent leasing program, all indicate pressure to develop a large oil shale industry. Our testimony addresses the air quality, water quantity/quality, solid waste handling, and people impacts of a massive 8 million BPD industry. We have also attempted to provide insight on what the ultimate size industry could be, given the existing environmental regulatory constraints.

Air Quality

An 8 million BPD industry would cause violations of existing health standards for photochemical oxidants, particulates, sulfur dioxide and possibly nitrogen oxides. This conclusion results from preliminary regional modelling studies performed for and by EPA. Figure 1 attached to this testimony shows the geographical extent of the predicted violations. Violations of the particulate matter and sulfur oxides standards will occur about 15 to 20 km beyond the development areas. However, the summary provided in Figure 1 underestimates the impact of SO_2 and particulate emissions because of the modelling technique used. Values which are being considered for a short term nitrogen oxides standard would be exceeded throughout the Piceance and Uintah Basins. It can be seen that violations of the ozone standard would be predicted throughout the entire study area. Several factors suggest that these results underestimate the impacts which would be expected.

1. A neutral (D) stability was used in the modelling study which represents good dispersion conditions. Much higher concentrations will occur frequently during the Fall and Winter due to the prevalence of inversion conditions which occur in the mountain valleys throughout both the Piceance and Uintah Basins.
2. The predicted concentrations do not consider the impacts from an additional 1.7 million people living in the Basin - a new Denver on the Western Slope.

3. Particulate emissions will increase if surface mining is used.
4. The SO_2 emissions may even increase unless the very stringent controls which Colony employed are provided. Occidental Oil Shale Inc. is proposing less control.

The existing concept of Prevention of Significant Deterioration of Air Quality (PSD) has been established by Congress and confirmed by the Supreme Court. The National Parks and Wilderness Areas shown on Figure 1 have been designated for special protection (Class I areas). All other areas are classified as Class II. Figure 4 of my testimony graphically describes the incremental amount of degradation allowed for each Class. An 8 million BPD industry could cause Class I violations at most Class I areas shown on Figure 1. Class II violations could occur out to distances of at least 50 km from the development areas (e.g. about as far as Glenwood Springs).

Attempts to predict ambient concentrations are associated with uncertainties. Perhaps a better perspective of the magnitude of the air quality impacts may be gained by making a number of comparisons. Knowledge of air quality situations in highly urbanized and industrialized areas, coupled with a comparison of their emissions with those from an 8 million BPD provide a perspective. Table 2 provides total emissions and emissions densities of an 8 million BPD industry compared with a number of Air Quality Control Regions. Some of the more graphic comparisons are . . .

Emission Densities

. PM	Oil shale	2X	NY NJ Conn AQCR
	Oil shale	15X	Denver
	Oil shale	2 1/2X	NY - DC coast
. NO_x	Oil shale	2 1/2X	NY NJ Conn AQCR
	Oil shale	15X	Denver
	Oil shale	5 1/2X	NY NJ Conn AQCR
. SO_2	Oil shale	=	NY NJ Conn AQCR
	Oil shale	8X	Denver
	Oil shale	=	NY - DC coast

An additional perspective may be gained by comparing the particulate emissions from an 8 million BPD industry to all coal fired power plants projected for construction in the U.S. between 1980 and 2000. They are essentially equal.

Further perspective on the air quality impacts may be gained by a discussion of the visibility impacts which would be associated with an 8 million BPD industry. The first set of pictures represent a view from Dinosaur National Monument looking ESE toward Ca and Cb. The second set represent a view looking SW toward the UaUb tracts. The first picture in each set represents visibility in Piceance and Uintah Basins on a good day. Existing visibility has been measured at better than 180 miles (300km). The 8 million BPD case would result in visibility much worse than the second picture. Calculations show that visibility would be reduced to less than 12 miles(20km) throughout the entire area.

Another air quality impact which cannot be quantified at this time is the effect of the nitrogen oxides and sulfur oxides emissions on precipitation quality. It is not unlikely to expect acid rain potential. Also, due to the technology of the retorting process, organic compounds may be emitted. The characterization and effect of these pollutants has not been adequately performed since there are no operating oil shale facilities.

Water Quantity/Quality

It takes 4 barrels of H_2O to produce 1 barrel of oil. An 8 million BPD industry would consume more than 1.6 million AFY. This is more than 10 percent of the Colorado River. The consumptive use of this amount of high quality Upper Colorado River Basin water translates into a salinity increase of as much as 80 mg/l. Salinity increases result in economic costs in the form of crop yield reductions, additional scaling and corrosion, use of additional soap, etc. At $450,000 per mg/l, this translates into a cost of more than $30 million per year to downstream users.

If Missouri River water were used, the pumps to transport the water would need electricity from a 3000 MW power plant. This size plant would demand the fuel equivalent of a 150,000 BPD oil shale facility.

Additional Reservoir capacity would be required. In order to assure a safe supply of water as much as 3 million acre feet of storage capacity would probably be required. This is more than three times the size of the three Gunnison River reservoirs of Blue Mesa, Morrow's Point, and Crystal. It is equal to a Flaming Gorge.

The water used by an 8 million BPD would be equivalent to the total consumptive use of half of all coal fired power plants to be built in the U.S. between 1980 and 2000.

As with the air quality analysis, this water discussion has not considered the needs and implications of an additional 1.7 million people. The cost of wastewater treatment facilities alone could be more than $500 million. Additional costs would be incurred for drinking water systems and fire protection needs.

Other water quality impacts resulting from an 8 million BPD industry which cannot be quantified at this time include:

1. Long term base flow reduction due to ground water withdrawal.
2. Increased stream concentrations of F, B, NH_4, and TSS due to mine dewater discharge.
3. Increased inorganic salts and organic material in the ground water and surface water due to spent shale leachate.
4. Increased organic concentrations in surface streams due to spills resulting from the operation of the equivalent of four Alaska pipelines.

Solid Handling

Hazardous and solid wastes will be generated by an oil shale industry. The acreage required for spent shale disposal from an 8 million BPD industry would be a nearly 3000 acre pile as tall as the Anaconda Tower Building (about 400 feet) every year during the entire operational life of the industry.

The logistics of mining the necessary shale to produce 8 million BPD of oil are staggering. About 3.2 billion tons of average grade (32 gpt) shale would have to be mined each year. This is more than 4 times the total coal mined (770 million tons) in the entire United States in 1979. The logistics of providing equipment and a labor force of that magnitude in a small 50 mile by 50 mile portion of Western Colorado are staggering. Another perspective may be gained by comparing the required mines to existing open pit copper mines. If all mining were performed via the open pit method, the equivalent of about 80 Bingham Canyon mines would be needed.

People

An 8 million BPD industry would demand a continuous operational work force of more than 160,000. Coupled with families and induced support population, the population of Western Colorado and Northeastern Utah would increase by about 1.7 million. The buildup to 1.7 million people over a 20 year time period would mean an increase of more than 80,000 people per year. That rate of increase per year is more than five times the present total population of the 4 county oil shale study area. Besides the air and water quality implications, this new population center would create extensive street, highway, transportation, and other public service demands. It would add extensive pressure to the recreational attributes of the Western Slope, i.e., hunting, fishing, and skiing.

Added to the people pressure on the deer and elk herd of the Western Slope would be the mere presence of 160 oil shale plants like Colony in the Basin. In order to physically accomodate this number of facilities, they would have to be placed on five mile centers.

Conclusions/Recommendations

There are numerous unanswered questions associated with oil shale development. Little quantitative data exist which accurately describe the expected type and magnitude of emissions, water effluents, and solid waste. Accurate comparisons among mining and retorting technologies are not possible. It is our opinion that answers to these broad questions and many specific questions which we have posed in previous presentations should be obtained while oil shale development proceeds to a modest level. Based upon the answers obtained, the size and mix of technologies which would constitute an optimal industry could be decided. Although there is an abundant resource available, proceeding too quickly toward oil shale development may result in inefficient use of the resource, severe environmental degradation, or mandate expensive retrofit controls. Despite the reasonably good baseline date gathering efforts by industry and government and attempts by the developers to conduct operations in an environmentally conscientious manner, there have still been some surprises. These include 1) extremely higher than anticipated amounts of ground water,2) extreme variations of sulfur composition of retort offgas, 3) water discharges in excess of NPDES limits, 4) ignition of raw shale/processed shale fines, and others.

Several aspects associated with oil shale development need attention if oil shale development proceeds in a manner which is not only good for the country but also right for Western Colorado and Northeastern Utah. These include ...

1. Accurate characterization of waste streams.
2. Development of proper analytical tools to predict the cumulative impacts associated with a large industry.
3. Investigation on the ability to use low quality water in the process.
4. Assessment of the effectiveness of conventional environmental control technologies.
5. Development of a mechanism to provide planning, financial, and technical assistance for community service needs.

The goal of 400,000 BPD shale oil production in the early 1990's established by the President and the Congress appears to be reasonable. It appears that this level and pace can be accomodated without jeopardizing existing environmental requirements and values. It appears doubtful that the ultimate size of the industry could be much more than 1 million BPD given what we know today.

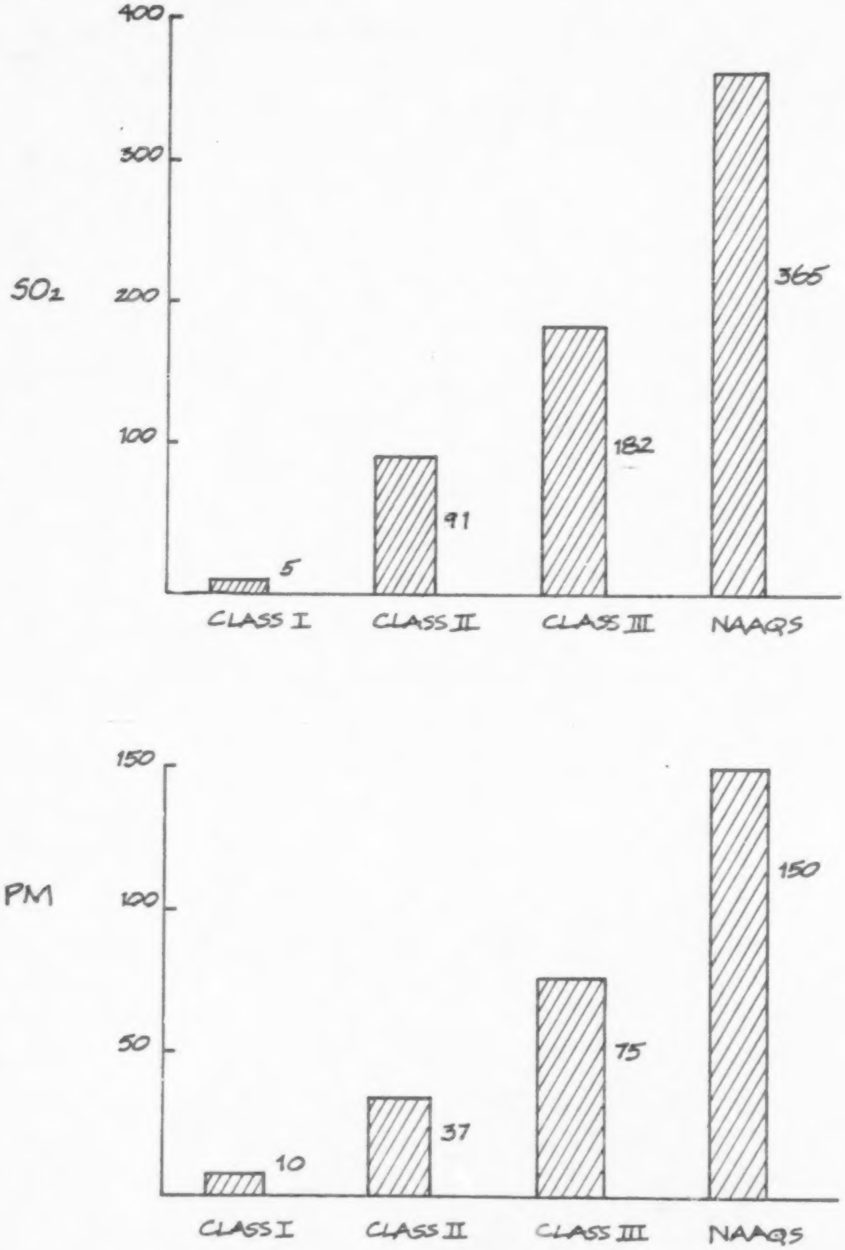

FIGURE 4
PSD AND NAAQS CONCENTRATIONS, ug/m3

TABLE 1
AIR QUALITY IMPACTS
BPD CONSTRAINT AND EXTENT OF VIOLATIONS

		BASIN			
		S. Piceance	N. Piceance	Uintah	TOTAL
O_3	1) Violations occur at	450	400	260	1110 K BPD
	distance	90 km +	100 km +	100 km +	
	2) 8 million BPD violations		"everywhere"		
NO_2	3) Violations occur at	2000	1100	400	3500 K BPD
	distance	to 15 km	to 10 km	to 10 km	
	4) 8 million BPD violations	to 30 km	to 75 km	to 35 km	
SO_2	5) 8 million BPD NAAQS violations				
	distance	to 20 km	none	none	
	6) Class II	to 30 km	to 15 km	none	
	7) Class III	to 25 km	to 10 km	none	
	8) Class I constraint	1000	750	1200	2950 K BPD
PM	9) 8 million NAAQS violations				
	distance	to 15 km	to 10 km	to 10 km	
	10) Class II	to 25 km	to 50 km	to 30 km	
	11) Class III	to 20 km	to 20 km	to 15 km	
	12) Class I constraint	4000	1400	3300	8700 K BPD

CLASS I AREAS

A. DINOSAUR NATIONAL MONUMENT (STATE)
B. MT ZIRKEL WILDERNESS
C. FLAT TOPS WILDERNESS
D. MAROON BELLS-SNOWMASS WILDERNESS
E. WEST ELK WILDERNESS
F. BLACK CANYON OF THE GUNNISON NATIONAL MONUMENT (STATE)
G. COLORADO NATIONAL MONUMENT (STATE)
H. ARCHES NATIONAL PARK

OIL SHALE SITES

1. C-a
2. C-b
3. COLONY
4. UNION
5. NOSR
6. MOBIL
7. CITIES SERVICE
8. CHEVRON
9. SUPERIOR
10. U-b
11. U-a
12. TOSCO SAND WASH

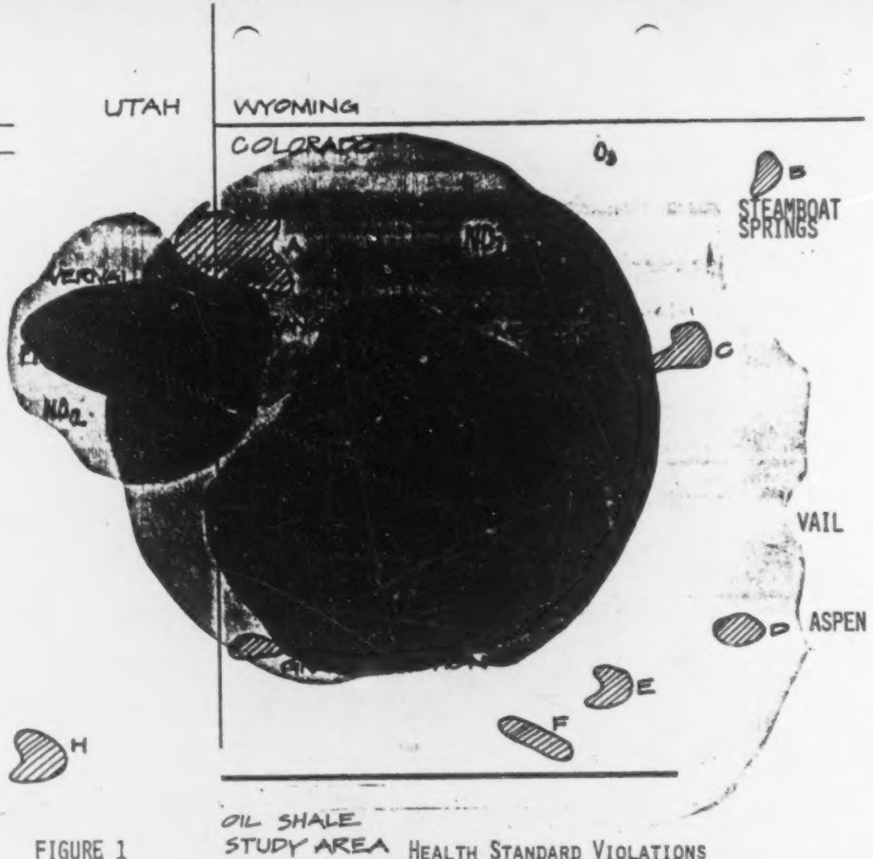
UTAH
WYOMING
COLORADO
O_3
B
STEAMBOAT SPRINGS
NO_2
VERNAL
A
C
NO_2
VAIL
D
ASPEN
E
F
H
OIL SHALE
STUDY AREA

FIGURE 1 HEALTH STANDARD VIOLATIONS

8 MILLION BPD CASE

CLASS I AREAS

A. DINOSAUR NATIONAL MONUMENT (STATE)
B. MT. ZIRKEL WILDERNESS
C. FLAT TOPS WILDERNESS
D. MAROON BELLS-SNOWMASS WILDERNESS
E. WEST ELK WILDERNESS
F. BLACK CANYON OF THE GUNNISON NATIONAL MONUMENT (STATE)
G. COLORADO NATIONAL MONUMENT (STATE)
H. ARCHES NATIONAL PARK

OIL SHALE SITES

1. C-a
2. C-b
3. COLONY
4. UNION
5. NOSR
6. MOBIL
7. CITIES SERVICE
8. CHEVRON
9. SUPERIOR
10. U-b
11. U-a
12. TOSCO SAND WASH

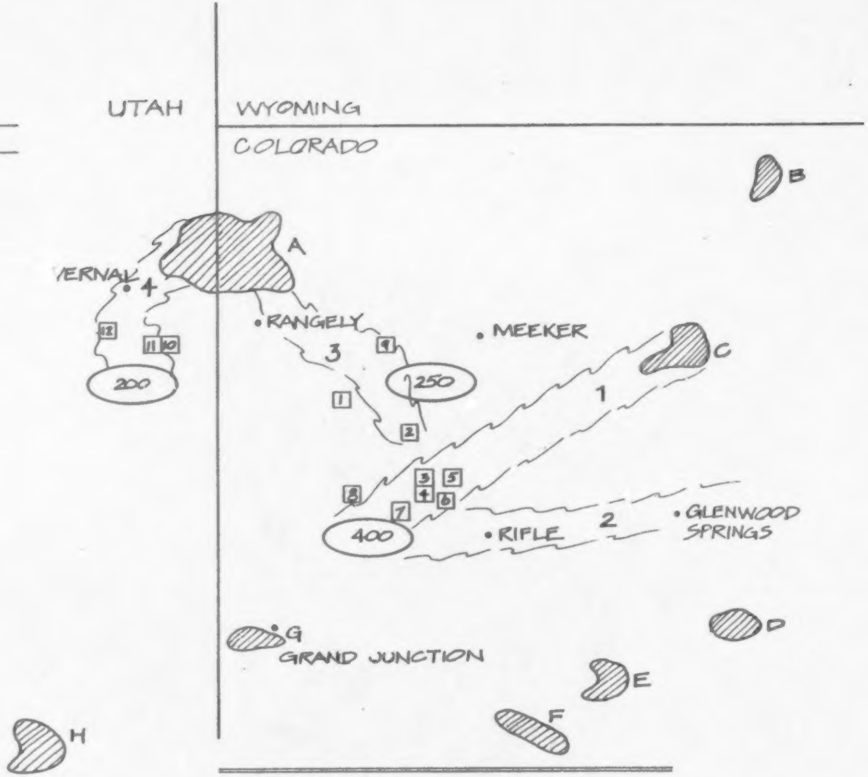
UTAH
WYOMING
COLORADO
B
A
ERNAL
4
12
11
10
RANGELY
9
MEEKER
C
3
200
250
1
1
2
3
5
4
6
8
7
400
RIFLE
2
GLENWOOD SPRINGS
G
GRAND JUNCTION
D
E
F
H

FIGURE 2
OIL SHALE
STUDY AREA-DISPERSION PATTERNS

Figure 3

PREDICTED SHALE OIL PRODUCTION LEVELS FROM WESTERN OIL SHALE RESOURCES
1980 – 1996
(BARRELS PER CALENDAR DAY)

MAR. 1980

	OIL SHALE PROJECTS		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
①	OCCIDENTAL OIL SHALE LEASE TRACT C-b	a	PILOT OPERATION, ENGR. PERMITTING, CONSTRUCTION				6,250	30,000	50,000	65,000	84,600	94,050	100,000	COMMERCIAL OPERATION					
②	PROJECT RIO BLANCO LEASE TRACT C-a	b	PILOT OPERATION, ENGR. PERMITTING, CONSTRUCTION				19,000	45,600	76,000	COMMERCIAL OPERATION ENGR, PERMITTING, CONSTRUCTION					90,800	111,600	135,000	COMMERCIAL OPERATION	
③	GEOKINETICS, INC UINTA BASIN	c	SAME AS ABOVE		5,000	5,000	10,000	15,000	25,000	40,000	50,000								
④	EQUITY OIL PICEANCE BASIN	d	PILOT OPERATION		PLANS DEPEND UPON OUTCOME OF PILOT OPERATIONS														
⑤	NAVAL OIL SHALE RESERVE PICEANCE BASIN	e	FEASIBILITY STUDY				DESIGN PERMITTING		CONSTRUCTION				28,000	41,500	50,000	COMMERCIAL OPERATION			
⑥	DEMONSTRATION OF ABOVE GROUND RETORTING (DOE - PON)	f	MODULE DESIGN	MODULAR PLANT CONSTRUCTION		8,000	4,000	END PROJECT											
⑦	DEMONSTRATION OF ADVANCED RETORT TECHNOLOGY (DOE - PON)	g	RESEARCH				PILOT TESTS, ENGINEERING, PERMITTING MODULE CONSTRUCTION						8,000	8,000	END PROJECT				
⑧	UNION OIL LONG RIDGE, PICEANCE BASIN	h	CONSTRUCTION		9,500	MODULE OPER. CONSTRUCTION		30,000	50,000	COMMERCIAL OPERATION SCALE UP							75,000	100,000	
⑨	COLONY/TOSCO PARACHUTE CREEK, PICEANCE BASIN	i	DESIGN, CONSTRUCTION				25,900	38,400	46,200	COMMERCIAL OPERATION									
⑩	TOSCO SAND WASH UINTA BASIN	j			PERMITTING CONSTRUCTION			23,100	46,200										
⑪	WHITE RIVER PROJECT LEASE TRACTS Ua, Ub, UINTA BASIN	k	EXACT SCHEDULE WILL DEPEND UPON OUTCOME OF LITIGATION													45,000	90,000		
⑫	CHEVRON OIL PICEANCE BASIN	l	ENGR, PERMITTING, PILOT MODULE CONSTRUCTION				7,000	15,600	24,200	32,800	41,400	50,000	66,600	83,200	100,000				
⑬	SUPERIOR OIL PICEANCE BASIN	m	PERMITTING, CONSTRUCTION					6,700	10,000	12,000	COMMERCIAL OPERATION								
⑭	MOBIL OIL PICEANCE BASIN	n	ENGINEERING, PERMITTING, CONSTRUCTION						6,000	6,000	30,600	42,500	50,000	COMM OPERATION SCALE UP			78,000	91,500	100,000
⑮	EXXON	o	ENGINEERING, PERMITTING, CONSTRUCTION						16,800	24,900	30,000	45,000	60,000	COMMERCIAL OPERATION					
⑯	CITIES SERVICES PICEANCE BASIN		NO DEFINITE PLANS AT THIS TIME																
	TOTAL PROJECTS		0	0	14,500	22,500	81,650	204400	350400	399,100	467000	511,950	593,000	623,100	655,200	721,000	842,400	880,900	889,400

Table 3

Health Effects of Air Pollutants

Ozone

Ozone is a bronchiopulmonary irritant which affects the mucous lining, other lung tissue, and respiratory functions. Changes in lung function as a result of high ozone concentrations appear as increased airway resistance and reductions in vital capacity and expiratory flow rates. Health effects may include shortness of breath, fatigue, coughing, chest soreness, and aggravation of pulmonary disease.

Particulate Matter

Particulate matter concentrations exceeding the NAAQS may injure surfaces in the respiratory system. Increases in morbidity and mortality may accompany excess concentrations. Acute worsening of chronic bronchitis effects may accompany elevated concentrations.

Sulfur Oxides

Sulfur oxides cause irritation to the respiratory system. Increased pulmonary flow resistance and bronchio constriction may occur. Respiratory infections may contribute to chronic bronchitis. Increases of morbidity and mortality may accompany high concentrations.

Nitrogen Oxides

Nitrogen oxides can impair the pulmonary function by increasing expiratory resistance and reducing maximal breathing capacity. Increased incidence of acute bronchitis and other respiratory diseases accompany high concentrations.

POSITION OF STATE ON DEVELOPING SYNFUELS INDUSTRY

Senator HART. Just so I understand the State's position on this matter, I will try to summarize it. And, Mr. Pascoe, you correct me if I get it wrong. It is your conviction, I take it the Governor's, that natural and human environment of northwest Colorado can accommodate and the collateral resources of water and air and so on can accommodate the industry in the 1980's of size roughly 350,000 to 400,000 barrels a day which, if you use 50,000-barrels-a-day plant standards, it would be 7 or 8. Is that correct?

Mr. PASCOE. That is correct. And that's the basis of my projection planning.

Senator HART. Have you projected or planned beyond that into the 1990's, presuming, if you will, all goes well, technology is approved, economics are established, and some assistance to the infrastructure, energy impact assistance or whatever? Have you projected beyond that decade?

Mr. PASCOE. We have not done specific projections beyond that period of time. But I did make the statement, and it was reaffirmed here, that I think we're talking about relatively modest increases, as I stated it, in the tens of thousands of barrels rather than in the millions of barrels after that period of time to increase production after that date.

MAXIMUM INDUSTRY SIZE

Senator HART. Do you have a maximum industry size?

Mr. PASCOE. We do have a maximum industry size. Right now it's clearly controlled by things such as some physical limits like air quality and water resources. And those practical limits right now would put it in the range of 500,000, 600,000, or 700,000 barrels a day. After that, we'll have to be much more sophisticated and careful with our resources as well as our planning for people to live in that area to accommodate much of the additional industry beyond that production

Senator HART. Can you envision an industry of the size of, say, 8 million barrels a day by the year 2000?

Mr. PASCOE. Well, I suppose I can envision that. But I think an awful lot of things would have to develop very well including some fairly dramatic technological breakthroughs in how we reach this resource and get the oil out and to the market.

FINANCIAL ROLE OF COLORADO IN SYNFUELS DEVELOPMENT

Senator HART. Understanding that your authority and repsonsibility is restricted to the natural resources department, do you have any views on the role the State should play financially in buffering whatever size industry we have in terms of impact assistance, cost sharing, water projects, and so on?

Mr. PASCOE. I think it's clear the State will have to play a role. I don't know that it can be quantified. Because of this acceleration and activity, we're going to have to talk to the legislature this fall about some additional resources just in the planning and keeping-up stage of it. We also are going to have to find some way to help these local communities do some bonding and take other steps to get the money to build the necessary facilities for the next few years, let alone 10 or 15 or 20 years from now.

But it's very difficult to quantify how much that is, because it seems to me that this is a national effort, federally driven, federally funded to obtain a resource for the benefit presumably of the entire Nation. And I think because of that a very heavy responsibility lies with the national government to assist its State and local governments in helping with this process.

Senator HART. Well, again, I want to thank both of you for excellent statements. They've been very helpful to our record. We appreciate it. Thank you very much.

Our next and final set of witnesses is a panel composed of Mr. John Hopkins of the Rock Mountain Oil & Gas Association and from the Department of Energy, Mr. Peter House and Mr. Ted Williams.

Mr. Hopkins?

STATEMENT OF JOHN HOPKINS, CHAIRMAN OF THE COMMITTEE ON OIL SHALE, ROCKY MOUNTAIN OIL & GAS ASSOCIATION

Mr. HOPKINS. I'm John Hopkins, president——

Senator HART. Again, I would urge all of you to speak as loudly as possible for the people in the back. Those systems don't seem to be working.

Mr. HOPKINS. I am president of the Energy Mining Division of the Union Oil Co. of California. I'm here today, however, as chairman of the Oil Shale Committee of the Rocky Mountain Oil & Gas Association.

The Rocky Mountain Oil & Gas Association has some 750-member companies. The Oil Shale Committee of that association has 27-member companies which encompass most of the companies that are seriously interested in oil shale development. Our Washington staff have worked hard to make sure the statement I'm about to present is something that our member companies of the Oil Shale Committee are comfortable with, so I'll stay pretty close to the text.

Senator HART. I'll again, in the interest of time, urge you to summarize where possible.

Mr. HOPKINS. The committee first wants to commend you, Senator, for your sponsorship and advocacy of oil shale initiatives. We are very thankful for your assistance in the passage of the $3-a-barrel tax credit, your sponsoring and leadership on the floor of the Senate on amendments designed to improve the economic climate for oil shale, your sponsorship of legislation to assist the local communities with the impacts associated with oil shale development, your cosponsoring of S. 2783 along with Senators Wallop and Garn to bring oil shale tax treatment up to an equal level with other synfuels, and your leadership as sponsor of legislation to allow off-tract access to Federal lands for oil shale leaseholders. This is a long and very impressive list of measures and accomplishments. While we recognize that you have other contituents, we are proud of our relationship and look forward to your continued support in the future.

On behalf of the pioneering oil shale industry, I thank you for the opportunity to appear before you today. I hope this meeting will reaffirm our commitment to the development of a new energy industry and a new energy resource that will provide a major supplement to America's domestic energy supplies in a manner compatible with our concern for protecting the environment. The Nation and the oil-shale industry are opening new ground, literally and figuratively. We must do it with a mutual anticipation of both the opportunities and the consequences of our actions and decisions. Thus, this hearing is very important.

POTENTIAL FOR DEVELOPMENT OF OIL SHALE IN THE FUTURE

We're here to discuss the potential for development of oil shale in the future; and to do so, we should start on common ground. First, and most obvious, America desperately needs to enhance her domestic supplies of energy. Oil shale offers the most promise of providing substantial amounts of synthetic crude oil which can be directly substituted for conventional petroleum products at a price competitive in today's market.

Indeed, oil shale offers the most ready means for America to provide a secure domestic source of supply for our Armed Forces, a subject which is especially important to you and your colleagues on the Armed Services Committee.

The shale is there as a known resource. With today's technology, oil shale is more economical than any other alternate to conventional petroleum. Thus, it is in the best interest of the people of the United States to produce a maximum amount of oil from shale at the earliest possible date.

ENVIRONMENTAL AND SOCIAL IMPACT OF OIL SHALE PRODUCTION

The first concern that many people have in connection with development of oil shale is the environmental and socioeconomic impact. Some people have demanded that shale oil production should not and must not make any impression or change on the quality of life or the way of life of any individual or community. We can appreciate that position, but we must also recognize that any kind of development, even on a modest scale, will bring changes to the rather small geographical area in which it takes place.

Development of a shale industry will present great challenges to all of us, one of the most important of which will be to assure that development moves forward in the least disruptive manner. But we must all recognize that any growth of any kind will cause change. I can assure you that we will all strive to protect the environment and the way of life in the areas of Colorado and Utah where we will live and work, but we must recognize that there will be change.

There has been considerable change in the local communities in Colorado and Utah in the last 10 to 15 years which is solely attributable to the growth in tourism, not resource development. The future holds more of both, and it is not necessarily bad.

LIMITS AND CONSTRAINTS ON OIL SHALE INDUSTRY

A second major topic for discussion is the question of limits and constraints on this new industry. These fall into two broad categories:

The physical and technological limits to development and the political limits. The second category is the more important.

It seems physically and technologically feasible to have production in the millions of barrels a day in the foreseeable future. That is a far cry. however, from what we see in today's political environment.

Significant numbers of restraints on the industry have been set out which have caused companies to either abandon or significantly restrain their hopes for development of their oil shale operations. In recent months, however, the climate has improved. The oil shale industry will be the first major new industry to be developed under the strict controls of numerous new pieces of legislation.

Among these new laws are the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Federal Land Policy Management Act, the Endangered Species Act, the Antiquities Act, the Wilderness Act, the Safe Drinking Water Act, the National Environmental Policy Act, and the Surface Mining Control and Reclamation Act. Recently, we have seen congressional approval of oil shale development, and companies are encouraged.

IMPACT OF DELAYS IN OIL SHALE DEVELOPMENT

We in industry have consistently maintained, since the committee was formed in RMOGA many years ago, that the major question facing Government and its leaders is not whether shale oil would be developed but when it would begin and at what pace. We face a choice between allowing oil shale to be developed at a reasonable, gradual pace or on a crash basis later in the face of a crisis.

These delays in the timing of shale's development can be directly translated into increased costs due to heavy impact of inflation on such large, capital-intensive projects. Only companies with significant amounts of optimism and money have been able to bear these burdens. While industry may be accused of not being able to move forward with the development of these projects due to the economic climate in which we exist, the economics have been significantly determined by the political environment in which we live.

The companies nearing development have had permit applications on file for many years with the State and Federal authorities and are now in a position to move forward with plant development. Other companies are currently evaluating their future in oil shale who possibly have a significant resource position but have not engaged in background monitoring necessary to begin preparation of an environmental impact statement. These companies are many years away from being able to build a plant and yet possess large amounts of technical and financial abilities and could make a more significant contribution in a better regulatory framework.

REVISE CLEAN AIR ACT

The Clean Air Act, in our opinion—and our position on this is supported by the recent study done by the Office of Technology Assessment for the Congress—will limit production of oil from shale in Colorado. Until the first plants are actually developed, no one will know precisely what the effect in the Piceance Basin and the Flattops wilderness areas will be. We think these impacts will be manageable and indeed a positive influence on the area if a new spirit of cooperation can be forged with Government and industry to manage them properly.

There is a good possibility that the simultaneous development of oil shale projects, coal projects, tar sands production, uranium production, desulfurization of natural gas production, and the development of the MX missile system will use all of the increments available under the PSD regulations and the Clean Air Act. This makes the competition for these increments quite strong and, more importantly, makes the future size of these developments questionable. The Clean Air Act should be revised to remove this uncertainty.

WATER QUALITY AND WATER SUPPLY

Water quality and water supply are continually referred to as problems which will limit the size of an oil shale industry. We feel that the State of Colorado's recent study clearly indicates that an industry of 500,000 barrels a day will not require tradeoffs to be made between agricultural and industrial or municipal use. That's good enough for starters, and we are confident that as the technology advances ways of reducing water requirements will be developed which, coupled with the full utilization of available water supplies, will permit an oil shale industry much larger than 500,000 barrels a day.

SOCIOECONOMIC IMPACTS OF OIL SHALE INDUSTRY

Turning to the socioeconomic impacts of an oil shale industry, the industry has made significant commitments to assuring the people of the affected areas that industry will do its utmost to cooperate with Federal, State, and local officials and to insure that planning for expansion of the infrastructure in the local communities is done as development proceeds.

Industry supported a 4-percent severance tax in Colorado to finance the cost of its presence in the State. We're very proud of having been responsive to the concerns of the officials at the local and State level, and think our commitment is demonstrated by our support for the tax. A 4-percent tax on the gross value of the plant's product is going to accrue huge revenues to the State of Colorado and we think offers an opportunity to assure that these concerns will be addressed adequately.

Make no mistake, however, that this signifies a deep, unabiding, and tangible commitment to seeing oil shale developed right the first time. Some developers have committed themselves to constructing new communities to provide single-family homes that are attractive and beneficial contributions to the local communities rather than simply parking trailer homes in orchards as we've seen in the area in the past with other kinds of growth. Other developers are taking positive steps to help the communities meet the needs of a growing population. There will be change; no doubt about it. But it can be progress rather than boom towns. We intend to work for that.

I might digress from the text here and point out the Oil Shale Committee has permission for Peat, Marwick & Mitchell Co. to make a study for us which will endeavor to show the tax revenues which will accrue to State and local Federal governmental units from an established industry once it gets established. Our objective in this is to try to point out the socioeconomic impact problem is one of front-end money, early money. Thus, your ideas of supporting Federal support of that financing problem for the local communities is very important, we think.

TECHNOLOGICAL AND PHYSICAL PERIMETERS OF OIL SHALE INDUSTRY

We submit that our estimates of the size of an industry have two perimeters: the technological and physical perimeter, which is very large given the nature of the resource base, and the other is the political perimeter, which is presently untested and unknown. The critical need is to begin development of shale oil industry now. The initial plants must be large ones of a commercial scale of approximately 50,000 to 100,000 barrels per day.

The President's goal of 400,000 barrels per day by 1990 is attainable if we proceed with the pioneer plants in a timely fashion. With the information and experience gained from these first-generation plants, we feel that we can multiply that figure several times and still meet all reasonable environmental parameters.

Beyond that, while we don't know how large the industry will become, we must begin now to plan for an industry of sufficient size to meet the Nation's needs during the 1990's and beyond. To do this, we must move ahead with plans for the second- and third-generation plants even while the first are being built.

We submit that the capability is physically much greater than the President's goal, given the size of the resource, and would remind you of the tremendous potential for technological advances in the second- and third-generation plants. These advances will quite probably make today's problems seem incidental. But the only way to find those answers is to begin today.

As I mentioned earlier, we need a new spirit of cooperation between Government and industry to manage the impacts of a growing industry. Such a partnership must have the resolve to look into the future and adequately plan for both development and impact absorption if it is to succeed.

Obviously, the questions of environmental tolerance and socioeconomic impact will influence the level of growth of the industry. Which level of production is more appropriate for America, for the region, for Utah and Colorado, are not questions we can answer. Those are questions which must be answered in public forums, and we appreciate the opportunity to be a part of such a forum today. In the meantime, we stand ready and willing to assist Americans in making oil shale a model of enlightened industrial development. Thank you, Mr. Chairman.

Senator Hart. Mr. Hopkins, thank you very much. That's a very valuable and helpful statement. We appreciate it. I do have a couple of questions, but I will withhold those until we hear from our other witnesses.

In the meantime, I'd also like to recognize the presence of State Representative "Wad" Hinman from northwest Colorado, who is a well-known State legislator who is vitally concerned with our discussion here today and these deliberations. The people of Rio Blanco and Moffat and Garfield Counties feel the immediate impact.

Representative Hinman, we're glad to have you with us.

Representative HINMAN. Thank you.

Senator HART. Now we'll hear from Dr. Peter House and Mr. Ted Williams from the Department of Energy.

STATEMENT OF PETER HOUSE, DIRECTOR, OFFICE OF ENVIRONMENTAL ASSESSMENTS, DEPARTMENT OF ENERGY, ACCOMPANIED BY TED WILLIAMS

Dr. HOUSE. Thank you, Senator Hart. I appreciate the opportunity to appear before this Senate Budget Committee hearing on oil shale development.

With your permission, I'll submit testimony for the record, and I'll summarize a few points in the testimony.

Senator HART. In each case, all of these prepared statements that were not read will appear in the record. I would urge you to summarize them.

GROWTH RATE AND MAXIMUM SIZE OF WESTERN OIL SHALE INDUSTRY

Dr. HOUSE. There are several policies that have been taken by the administration and by the Congress over the last year or two involving energy independence. The most recent is the Synthetic Fuels Corporation. It's designed to create a diversified synthetic fuels industry of at least 500,000 barrels per day by 1987 and 2 million barrels per day by the year 1992.

It's clear that oil shale is expected to be a major contributor to the future synthetic fuels production of this country.

I would like to turn now to the specific questions you addressed to the Department of Energy with respect to the growth rate and maximum size of a Western oil shale industry. The Department and its predecessor organization, the Energy Research and Development Administration, have in the past attempted to address this question. These previous studies have been inconclusive and led to widely varying predictions because data was not available from actual commercial operations and the prediction models used were imprecise tools. However, we must say that none of these studies identify any serious impediments to reaching the goal of 400,000 barrels per day.

I would like to narrow the focus still more if I could to a study which is in printing now and will be out in a couple of weeks which I have a draft copy of here, "Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis." The predecessor to this document was the environmental part of an interagency task force report that was put together by the administration in its preparation of its synfuels proposal. Its purpose was to see if there were any environmental constraints that would prevent a synthetic industry of 1.5 million barrels a day and, specifically of interest to you, of 400,000 barrels of shale oil a day. With your permission, in the testimony information taken from that document which includes a few examples of the types of things we are concerned with here. Let me just talk about air quality, if I may.

Senator HART. Try to keep your voice up for the people in the back of the room.

Dr. HOUSE. I beg your pardon.

AIR QUALITY

In the air quality area, in oil shale we looked at four different plant configurations, two surface retorts and two modified in situ. We also used three models, the CDM model, the Creston model, and the Valley model, and performed calculations using the four configurations and three models to try and find out if we could come up with estimates as to whether any of these configurations would give us a problem at 400,000 barrels a day.

In general, we find that with judicious plant design and siting, we would be able to have an oil shale industry at or above the projected 400,000 barrels a day with full compliance to air pollution control requirements with the safety factor at the 400,000-barrel-per-day level of at least 2 to account for model error, associated growth, and variation in actual to design factors.

WATER AVAILABILITY

In the area of water availability, we lean most heavily on a study done for the Water Resources Council by the Colorado Department of Natural Resources pursuant to section 13(a) of the Federal Nonnuclear Energy Research and Development Act funded by my office, within the Department of Energy.[1]

The study entitled, "The Availability of Water for Oil Shale and Coal Gasification Development in the Upper Colorado River Basin," suggested that there was a possibility that by the year 2000 an oil shale capability of 1.3 million barrels per day, 800,000 to 900,000 of which was in Colorado, could exist.

Two other areas which might be of some interest, one of which——

Senator HART. Let me be sure I understand. This record is going to be pretty complex. Mr. Slick testified that Exxon estimates there's enough water in Colorado systems to support an industry of 1½ to 2 million barrels a day. Mr. Pascoe testified that there is sufficient water in the Colorado system without adversely affecting agriculture or our existing uses to support an industry I think of 400,000, no more than 500,000. Your estimates are 900,000 barrels a day, somewhere in between?

Dr. HOUSE. Let me answer that. The estimate we have, by the way, that I just used there came from the Colorado Department of Natural Resources in its WRC report. Their base line was 1.3 million barrels a day by the year 2000. The part that was located in Colorado is someplace in the area of 800,000 to 900,000.

If I could, I might want to say water is just as critical an area as air or anything else. Some of the problems with some of the estimates that I've heard today, depend upon when the study was done and what source it was called from. The recent OTA study and several other scenarios, for example, which we looked over to prepare for this hearing, give estimates that range all the way from 400,000 to 2 million barrels a day.

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[1] See letter to Senator Hart from Dr. House submitted subsequently on water availability, p. 83.

Senator HART. In other words, what you're saying is we don't know whether Mr. Pascoe is right or Mr. Slick is right.

Dr. HOUSE. It depends on which study you'd like to look at.

Senator HART. Is this not an imperical matter? That is to say, is it not a factual question that reasonable people can—that's a margin of 250 percent or more.

Dr. HOUSE. I agree. The study that we were——

Senator HART. We've been setting water quantity in this State for 50 to 75 years.

Dr. HOUSE. As you will remember, the focus of our study at the Department of Energy was whether it was feasible to do 400,000 barrels a day.

Senator HART. I understand.

GROUND WATER

Dr. HOUSE. There is no study that we know of now that says the 400,000-barrel-a-day mark cannot be reached, and that was enough for this particular study.

I also might suggest—although I've heard no discussion of it today and we did not go into it in detail for our particular study but looked at it for a couple of sources for your hearing—that the issue of ground water is quite important. And the range there is equally large. The Colorado Department of Natural Resources report looked at drawing water from aquifers which were recharged, and estimated 24,000 to 29,000 acre-feet of such ground water in the Piceance Basin, or enough for about 250,000 barrels per day.

OTA's recent study looks at this. If you mine the water, it could support as much as 1 million barrels a day. That's on top of the surface water. These things have not been brought together yet and seems to be a more conservative estimate. The 400,000, however, does not seem to be a large problem.

Senator HART. Mr. Pascoe put an enormous responsibility on the Federal Government for this, for what's been done already and for what's being done in the future. If you accept his premise, should it not also be the Federal Government's responsibility to determine as quickly as possible what the facts are about the water? And how long do you project it will be before we can do that?

Dr. HOUSE. Well, I believe the Water Resources Council in its Upper Colorado Basin study did that. Working with the Department of Natural Resources it came up with an estimate of 1.3 million in the year 2000. And that, again, was surface water.

Senator HART. Well, what I'm really interested in is taking this whole thing over to western Colorado and doing it again at which time I would hope that each of the witnesses involved can begin to refute the other because Mr. Pascoe 15 minutes ago, as the State's leading water expert, did not say that. So something is wrong somewhere.

Dr. HOUSE. I'm merely quoting from the record.

Senator HART. I understand; please proceed.

Table 2

(1) From City-County Data Book
(2) From 1975 Nat. Emissions Report

EMISSIONS DENSITY COMPARISONS

Region	Square Miles(1)	Particulate Matter(2)		Nitrogen Oxides(2)		Sulfur Oxides(2)	
		T/YR	T/YR/MI^2	T/YR	T/YR/MI^2	T/YR	T/YR/MI^2
Oil Shale	2500	160,000	64	1,100,000	440	200,000	80
NY-NJ-Conn.	5019	191,170	38	878,782	175	361,219	72
NJ Intrastate	1978	16,395	8	46,289	23	47,597	24
Philadelphia	4146	165,251	40	391,146	94	456,536	110
S. Delaware	1544	6,793	4	25,122	16	49,481	32
Baltimore	2256	69,872	31	159,332	71	124,216	55
E. Shore, Md.	3393	3,989	1	23,960	7	9,842	3
S. Maryland	1049	8,265	8	29,653	28	63,547	61
D.C.	2326	62,945	27	190,196	82	203,124	87
Total Coastline NY-DC	21711	524,680	24	1,744,480	80	1,315,562	61
Houston Galv	11734	186,309	16	418,367	36	235.060	20

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EMISSION DENSITY COMPARISONS

Region	Square miles	Particulate Matter		Nitrogen Oxides		Sulfur Oxides	
		T/YR	T/YR/MI^2	T/YR	T/YR/MI^2	T/YR	T/YR/MI^2
Oil Shale	2500	160,000	64	1,100,000	440	200,000	80
New Jersey State		130,404		504,256		314,987	
Delaware	1983	30,382		72,607		224,718	
Colorado	103,797	57,610		241,725		117,135	
Denver AQCR	4,203	16,589	4	119,202	28	41,886	10
California	156,537	557,612		1,451,248		494,856	
Maryland	9,888	131,396		319,351		353,460	
Pennsylvania	45,026	722,312		1,039,418		2,134,470	
Massachusetts	7,833	95,966		397,183		304,621	
Utah	82,381	104,175		124,651		188,099	
Wasatch AQCR	3,656	81,137	22	83,180	23	165,326	45

SOLID WASTE

Dr. HOUSE. Thank you. In the solid waste area, we picked up that, as an example of an environmental uncertainty, which was clearly dependent upon a promulgation of regulation. If oil shale wastes, which are considerable, are eventually classified as hazardous, which they have not been in the recent promulgation of the Resource Conservation and Recovery Act, there should be significant cost increases, as much as three times the present estimates. Perhaps we're limiting disposal site availability as well.

SOCIOECONOMIC IMPACT OF OIL SHALE INDUSTRY

Last, and possibly more important, in the uncertainty area are socioeconomic concerns. The Department of Energy certainly recognizes that one of the major institutional constraints which could constrain development and deployment of a synthetic fuels or oil shale industry is its socioeconomic impact. As evidenced by our support of Senate bill 1699, which we feel will accomplish the basic objectives of initiating a comprehensive energy impact assistance program, the Department is vitally concerned with this area.

As we indicated in our supporting testimony for Senate bill 1699, the requirement to manage adverse socioeconomic impacts in an effective manner through various Federal, State, local, and private sector mechanisms is essential.

The severity of this problem has been further recognized by the Department's Office of Resource Applications which has provided grants to affected shale areas, its affected States, counties, and Indian tribes. These grants, totaling $2.5 million this fiscal year, are a means to help develop local expertise and management capability for dealing with these impacts as well as for socioeconomic planning.

In summary, the analysis undertaken by the Office of Environment does not reveal any serious impediments to the development of a 400,000-barrels-per-day oil shale industry by the early 1990's if properly planned and coordinated. However, the 400,000-barrels-per-day goal is reasonably safe and a necessary step for achieving whatever level of shale oil production ultimately proves to be feasible.

I'd like to again suggest that all of the parameters that were used in these studies to-date have been used on the basis of data from pilot plants—we have no commercial plants—and the use of imprecise tools. Many of the air pollution estimates that you've got, the differences by plant configuration and modeling are large indeed. We need yet to develop better models, better information, and better planning and coordination mechanisms to mitigate social and ecological disruptive impacts.

In this regard, Senator, we are aware of your relentless support for impact assistance for inland States. The acceptable growth rates and the capacity of the industry may prove to be more sensitive to the wisdom with which we manage socioeconomic impact than to any other factor.

I thank you for the opportunity to appear before you today and would be happy to try to answer any questions you may have.

Senator HART. Thank you very much, Dr. House.

PREPARED STATEMENT OF PETER HOUSE, DIRECTOR, OFFICE OF ENVIRONMENTAL ASSESSMENTS, DEPARTMENT OF ENERGY

Senator Hart, I appreciate the opportunity to appear before this Senate Budget Committee hearing on oil shale development.

As you know, the President, in his July 15, 1979, energy address to the Nation, set a limit to the amount of oil this country will import at the level of 1977. He also set the further goal of cutting our dependence on foriegn oil by 50 percent by 1990 - a reduction of over 4.5 million barrels per day of imported oil. To help meet his 1990 import reduction goal, the President proposed the development of 2.5 million barrels per day of oil substitutes from coal liquids and gases, oil shale, biomass, and unconventional gas. Of this 2.5 million level, 400,000 barrels per day (BPD) was the shale oil production goal. This remains the goal of the oil shale commercialization program being carried out by the Department of Energy.

Subsequent to the President's energy address, Congress acted to create the Sunthetic Fuels Corporation, whose purpose is to provide financial assistance to synthetic fuel developers. The goal of the Corporation, as outlined by the Congress, is to foster the creation of a diversified synthetic fuel industry of at least 500,000 barrels per day by 1987, and 2,000,000 barrels per day by 1992. (These goals do not include fuels from biomass and unconventional gas, which were included in the President's earlier program.)

It is clear from the projections that oil shale is expected to be a major contributor to the future synthetic fuels production of this country. In the recently annouced assignment of awards for the Alternative Fuels Production Program, 4 oil shale projects were selected totalling 12.8 percent of the $100 million feasibility study effort. These feasibility studies are designed to determine whether a specific project is technologically, financially, and environmentally viable.

I would like to turn now to the specific questions you addressed to the Departmnt of Energy with respect to the growth rate and maximum size of a Western oil shale industry. The Department, and its predecessor organization, the Energy Research and Development Administration, have in the past attempted to address this question. These previous studies have been inconclusive and lead to widely varying predictions because data was not available from actual commercial operations and the prediction models used were imprecise tools. The studies do not identify any serious impediments to reaching the goal of 400,000 BPD. Thus, the initial increment of 400,000 BPD is both a safe and necessary step to achieving whatever maximum capacity is ultimately established for the oil shale industry. Similarly, no precise determination of growth rate is possible; however, the institutional constraints (permits, land and regulatory problems) for planned projects probably will limit growth to safe rates in the initial period of oil shale development.

The most recent study examining this question is "Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis." The purpose of this study was to determine: a) whether the level of development of the proposed program was environmentally feasible, and b) which environmental and regulatory impacts could cause the greatest impediments to pace or size of deployment of synthetic fuel technologies.

For purposes of the study, four separate resource regions were assessed. One of these, the Four Corners/Rocky Mountain Resource Area, contained nearly all the high grade Western oil shale. A siting opportunities analysis was undertaken in each of these regions considering air quality, water resources, socioeconomic impacts, and ecological sensitivity.

AIR QUALITY

My office conducted an air quality impact analysis of potential oil shale technologies and included results in the previously referenced synfuels document. Some of the principal findings of this analysis are:

- There is no single representative shale technology and, therefore, there is no single pollutant emission rate per unit of shale oil production. For example, for a 50,000 BPD plant, particulate emissions could vary from 320 to 1800 tons per year, for well-controlled plants of different designs. Sulfur dioxide emissions could similarly vary by a factor of four between technologies.

o Variation in stack designs and local terrain relief could significantly change ambient impacts from plants with similar emissions.

o In relatively flat terrain, no proposed technologies exceeded PSD Class II increments for particulates or SO2 for a 50,000 BPD plant. However, two plant designs would exceed PSD Class I increments for both particulates and SO2 if the plant site was within 7-10 miles of the Class I area.

o With the same stack design, the Valley model indicated irregular terrain could change the ambient impact of a given emission rate by more than an order of magnitude. Hence, site selection, the Environmental Protection Agency's tall stack policy, and the Environmental Protection Agency's approved modelling techniques are all instrumental in establishing perceived limits for oil shale development, and only actual experience will establish the ultimate capacity of the oil shale industry.

o Concentrations of 25 kilometers were generally about one-fourth the magnitude of maximum concentrations close to the plant. Hence, plants separated by such distances should not interfere with each other's compliance with Class II increments.

o Due to the small increments allowed, several plants in a general locale would exceed PSD increments in a distant (30-50 km) Class I area.

- o A general assessment of the oil shale resource areas and the above findings indicated judicious plant design and siting would enable production of oil shale at or above the projected 400,000 BPD objective with full compliance with air pollution control requirements with a safety factor at the 400,000 BPD level of at least two to account for model error, associated growth and variaiton in actual-to-design factors.

WATER AVAILABILITY

Our synfuel analysis relied heavily on a major water-for-energy assessment that was recently completed for the Water Resources Council by the Colorado Department of Natural Resources pursuant to Section 13(a) of the Federal Non-Nuclear Research and Development Act, and funded by the Department of Energy. The study, titled "The Availability of Water for Oil Shale and Coal Gasification Development in the Upper Colorado River Basin," addressed a hypothetical baseline scenario in the year 2000 of 1.3 million barrels per day of oil shale and eight coal gasification plants (or a total of 1.5 million barrels per day liquids-equivalent). It concluded that the water demands of such an industry and its associated growth could be satisfied from surface supplies without having to impact other projected consumptive uses in the Upper Basin. This conclusion is made considering four major premises:

1. That water is purchased from existing Federal reservoirs and/or new reservoir, pipeline, and pumping facilities are built to store and transport the water. The study estimates the total capitalized cost of such construction at $1 billion, for a 1.5-million-barrel-per-day industry. This cost would be no more than 1 or 2 percent of the capitalized costs of the energy facilities proper.
2. The study did not project water requirements for instream flow protection which may be reserved at some future time.
3. No attempt was made to assess the impact that Federal environmental regulatory laws and programs may have on the development of water resources in the Basin.
4. The Upper Colorado River Basin Compact allocates set percentages of the total Upper Basin water to each Upper Basin state. Therefore, it is possible that the level of development in any one state could be limited due to its water allocation.

✓

Somewhat offsetting these qualifications is an assumption that maximized all nonemerging energy technology consumptive water uses in the Upper Basin to the year 2000: if future depletions by these uses were to fall short of the study's assumed "worst case" projection, then water would be available for an even higher level of synfuel development or institutional restrictions at the proposed level would be eased.

I should say at this point that when air and water constraints were combined for the oil shale region, the majority of areas had a medium to high relativity of siting ease.

SOLID WASTE

Another major environmental uncertainty for oil shale appears to be the safe disposal of extremely high volumes of spent shale from surface retorting operations. If oil shale wastes are eventually classified as hazardous, significant cost increases and perhaps more limited disposal site availability could result.

SOCIOECONOMIC CONCERNS

The Department of Energy certainly recognizes that one of the major institutional constraints which could constrain development and deployment of a synthetic fuels or oil shale industry is its socioeconomic impact. As evidenced by our support of Senate Bill 1699, which we feel will accomplish the basic objectives of initiating a comprehensive energy impact assistance program, the Department is vitally concerned with this area. As we indicated in our supporting testimony for Senate Bill 1699, the requirement to manage adverse socioeconomic impacts in an effective manner through various Federal, State, local and private section mechanisms, is essential.

The social and economic impacts that will affect the comparatively rural oil shale regions of Colorado and Utah and will result in a high degree of community growth and change were also assessed in the synfuels analysis. A method was developed to estimate regional growth absorption capacity for these socioeconomic impacts. Population characteristics in these areas were used as a surrogate to measure key socioeconomic disruption factors resulting from the influx of large numbers of construction workers, followed by a possible dropping off of population upon facility start-up and operation.

The overall results of this analysis established a means of comparison in terms of difficulty in accepting rapid industrial growth without major outside support. The absolute measure of whether these growth impacts are tolerable could not be made; this would have required detailed study of specific state and local mechanisms, based upon specific development plans that are now being formulated.

The oil shale resource areas of Colorado and Utah have primarily low to medium-low assimilative capacities. Essentially this means that this region will require careful planning, extensive cooperation between the community, the state government, and the developer, and adequate construction lead times. Otherwise, patterns of disruptive growth as seen in past boom-bust cycles in certain Western areas could occur.

The severity of this problem has been recognized by the Department's Office of Resource Application which has been distributing grants to affected states, counties, and Indian tribes in shale areas. These grants, totalling $2.5 million this fiscal year, are a means to help develop local expertise and management capability for dealing with these impacts, as well as for socioeconomic planning. Such programs are not new to Western areas; similar programs have been increasing our abilities to support local capabilities in Colorado and other Western locales.

Today there are a large number of Federal programs which are available to assist States and local communities experiencing growth-related problems. These programs are inventoried in the Match 1978 report to the President, Energy Impact Assistance. But in case these programs ultimately prove to be inadequate because of program gaps and size, the Administration also supports S.1699 with modifications which are based on our experience with existing programs.

CONCLUSION

In summary, the analysis undertaken by the Office of Environment does not reveal any serious impediments to the development of a 400,000-barrel-per-day oil shale industry by the early 1990's, if properly planned and coordinated. However, the 400,000 BPD goal is a reasonably safe and a necessary step for achieving whatever level of shale oil production ultimately proves to be feasible. While it would allow our oil shale reserves to begin to contribute to our need to reduce oil imports, this start would reduce the likelihood of a subsequent crash program. Such crash programs would involve growth rates and levels of production which may lead to unacceptable risks to the environment and the quality of life in Colorado.

All of the parameters we have studied to date have been assessed with somewhat imprecise tools. For instance, there is a need to do more to develop a reasonably accurate rough terrain model suitable for western oil shale areas; to gain more experience in siting actual facilities so that the attitudinal and institutional barriers to water use for synfuels can be recorded, to develop better planning and coordination mechanisms to mitigate social and ecological disruption impacts.

In this regard, Senator, we are aware of your relentless support for impact assistance for inland States. The acceptable growth rates and the capacity of the industry may prove to be more sensitive to the wisdom with which we manage socioeconomic impact than to any other factor.

I thank you for the opportunity to appear before you today, and would be happy to try to answer any questions you may have.

Department of Energy
Washington, D.C. 20585

August 20, 1980

Honorable Gary Hart
United States Senate
Washington, DC 20510

Dear Senator Hart:

At the Senate Budget Committee hearing in Denver on July 17, 1980, you expressed some concern about the apparent discrepancies concerning the magnitude of Colorado oil shale development which could be supported by available water resources. Although I cannot speak directly to the estimates given by the other witnesses in your hearing, I will try to shed some additional light on the data presented in my testimony.

For my statement, I relied primarily on the draft assessment completed recently for the Water Resources Council by the Colorado Department of Natural Resources, pursuant to Section 13(a) of the Federal Non-Nuclear Energy Research and Development Act, and funded by the Department of Energy. This assessment, titled "The Availability of Water for Oil Shale and Coal Gasification Development in the Upper Colorado River Basin," examined two hypothetical levels of energy development for the year 2000. The baseline scenario consisted of 1.3 million barrels per day of shale oil production in the region, and 2 billion cubic feet per day of high-Btu coal gasification. Of this total, 825,000 barrels per day of shale oil development were assumed to be sited in Colorado: 625,000 barrels per day on the White River (Water Accounting Unit # 140500C), and 200,000 barrels per day on the Colorado River Upper Main Stem (Water Accounting Unit # 140100).

The major conclusion of the assessment as noted in the Executive Summary is as follows:

> "It is estimated that the water demands of an emerging energy technology industry of about 1.5 million barrels per day oil equivalent (an oil shale industry of 1.3 million barrels per day and a high Btu gasification industry of about 2 billion standard cubic feet per day), as well as the water demands of the associated growth, could be satisfied from surface supplies without having to significantly reduce (if at all) other projected consumptive uses in the Upper Basin."

This conclusion is based upon four major premises:

1. That water is purchased from existing Federal reservoirs and/or new reservoirs, pipelines, and pumping facilities are built to store and transport the water. The study estimates the total capitalized cost of such construction at $1 billion, for a 1.5 million barrel per day industry, which would be no more than 1 or 2 percent of the capitalized costs of the energy facilities proper.

2. Water requirements for instream flow protection, which may be reserved at some future time, were not projected.

3. No attempt was made to assess the impact that Federal environmental regulatory laws and programs may have on the development of water resources in the basin.

4. Since the Upper Colorado River Basin Compact allocates set percentages of the total Upper Basin water to each Upper Basin state, it is possible that the level of development in any one state could be limited due to its water allocation.

The Colorado Department of Natural Resources' report also assessed an accelerated level of synthetic fuel development that consisted of 2,440,000 barrels per day of shale oil and 2.5 billion cubic feet of high-Btu coal gasification. Of the oil shale production total, 1,700,000 barrels per day of shale oil were assumed sited in Colorado: 1,200,000 barrels per day on the White River, and 500,000 barrels per day on the Colorado Upper Main Stem. Although the Executive Summary of the report does not explicitly make any reference to the accelerated case, Chapter 7 of the report does provide some insight to this higher hypothetical level of development. Referring to the siting of oil shale on the White River, the report states:

> "It is evident that sufficient amounts of surface water could be developed in the White River Basin to satisfy the demands of either of the postulated levels," the cases are 625,000 BPD and 1,200,000 BPD for the White River Water Basin, ". . . of emerging energy technology development . . . with a highly coordinated scheme of reservoir regulation, and, if possible, considerable aggregation of individual water right holdings . . . The total estimated annualized cost of developing water for either of the emerging energy technology projections is still only 2-3 percent of the total estimated capitalized cost of constructing and operating the postulated oil shale industry itself (in this basin)."

The report goes on to assess the siting of oil shale facilities drawing upon water from the Upper Colorado Main Stem. It concluded that, for either scenario, ". . . a small amount of storage would be needed," and that ". . . the needed storage would be small." It also concluded that ". . . the hydrologic impacts of emerging energy technology development in this basin would be insignificant."

The report did not try to estimate the potential for drawing upon groundwater reserves in the Piceance Basin. It did point out, however, that the average annual discharge from and recharge to the aquifer system is between 24,000 and 29,000 acre-feet. This quantity of water could, if ever called upon, support approximately 250,000 barrels per day of oil shale production on a continuing basis. The total volume of groundwater stored in the basin has been estimated to be as low as 2.5 million acre-feet and as large as 25 million acre-feet.

I trust that this additional information, drawn entirely from the Colorado Department of Natural Resources' assessment that was provided to the U.S. Water Resources Council, which I believe to be the most current and comprehensive analysis of its kind for this region, provides some enlightenment with regard to the quantitative estimates that I mentioned in my testimony before you on July 17.

I will be pleased to answer any other questions that you may have in the future regarding this issue. I look forward to my appearance before your committee in Rifle on August 29.

Sincerely,

Pete House

Peter House
Director
Office of Environmental Assessments

cc: Ruth C. Clusen
Assistant Secretary for Environment

Monte Pascoe

AVAILABILITY OF WATER FOR OIL SHALE INDUSTRY

Senator HART. I appreciate everyone's appreciation for the energy impact legislation. I wish the industry and administration would become a little bit more vigorous in the halls of Congress in their support, not just telling me how much they appreciate my efforts. We might have gotten the bill passed a year or two ago if we'd had that kind of cooperation.

Let me see if I can restate this environmental constraint issue particularly as it applies to water, because I think it's fairly critical in two ways, critical for itself and also critical for what it says about our lack of consensus about the facts. We are on the threshold of developing a major new industry in this country. Mr. Pascoe, rightly I think, says that at least a part of the reason for that is actions taken by the Federal Government in the last few months passing certain legislation. The industry says the Government is dragging its feet. The State of Colorado is saying the Government is going too fast.

In any case, what troubles me is we've got here today some of the best experts in the State and Federal and industry. We're still far apart on the facts having to do with critical resource for the industry, water.

Now, I understand that there is—you could define a consensus that there is sufficient unused or unappropriated or unavailable water to support an oil shale industry in the State of Colorado by the year 1990 of somewhere between 500,000 and 1 million or I guess in your numbers—well, 1 million. Is that correct? 900,000?

Dr. HOUSE. In the year 2000.

Senator HART. Mr. Pascoe?

Mr. PASCOE. May I help on this?

Senator HART. Yes.

UNUSED WATER RESOURCES

Mr. PASCOE. The report referred to is a report on the Upper Colorado River Basin which is a very, very substantial geographic area. When we speak specifically about the oil shale industry, it's a much more restricted geographic area. And when I speak about the oil shale industry, I of course have to speak about it from the standpoint of the State of Colorado as opposed to Utah or Wyoming or some other place.

The difficulty here is there are substantial water resources that are unused in that corner of Wyoming that the Green River runs through, and there are far less substantial resources that are unused in Utah and even far less in the State of Colorado. That produces some confusion about these gross numbers that we do use. I'll try to get them straightened out for you.

DISPARITIES IN WATER AVAILABILITY PROJECTIONS

Senator HART. That would be extremely helpful. I think that bit of information helps a great deal. I guess what bothers me is we're not off by a factor of 10 percent but a factor of 2 or 300 percent in terms of water available. That disparity bothers me a great deal, because we haven't gotten our heads together at the Federal and State level on that critical fact.

It seems to me we're behind the actual development of the industry. In other words, I think Mr. Pascoe and I agree the industry is going forward and yet the Government is playing kind of a catch-up role as to what the facts are with regard to available resources. I'm going to do what I can working with the Governor and other agencies and the Federal agencies to narrow that disparity to the minimum as quickly as we can.

I think we've got the resources. W've got the Water Resources Council and all sorts of other Federal and State agencies. We ought to get that down to a disagreement no more than 10 or 20 percent at the most.

But in any case, the point I want to make is not so much the disagreement between the State of Colorado and the Federal Government but the range of disagreement between both of you, if you will, representing those two levels of government and Exxon which says there's enough water around from the basin for 2-million-barrel-a-day industry and somewhere else water available for an 8-million-barrel-a-day industry.

I guess if this hearing is to accomplish anything, it's to put all of these views into some kind of perspective. Here you have the State of Colorado saying, "We may have enough water for 6 to 8 oil shale plants," and the Federal Government saying, "We may have enough water for a dozen to 15 or maybe even 20 oil shale plants," and Exxon saying, "We've got enough water for 40 oil shale plants and beyond that 150." That's the whole purpose of this hearing, to get some of these numbers in some kind of perspective.

VIEWS OF ROCKY MOUNTAIN OIL & GAS ASSOCIATION

Mr. Hopkins, I would like to try to summarize your testimony as in contrast with what I've heard from Mr. Slick. I believe that you as a representative of the Rocky Mountain Oil & Gas Association in effect put your organization on record in favor of an incremental development of an oil shale industry at its initial stages somewhat more modest than Exxon and not willing at this time at least to put yourself on record as to where the ultimate size of that industry should be; is that correct?

Mr. HOPKINS. I think the early part of the statement might be at variance with what we meant to say. We believe that an oil shale industry certainly by the late eighties on the order of 400,000 barrels a day is achievable. I think that's about the same level of activity in that interval of time that Mr. Slick forecast. So I don't think we are at variance with him in that regard in the basic approach to getting these pioneer plants built as soon as we can so we find out what they are.

You're correct in the latter part of your statement, that we have not undertaken a forecast Exxon has out into the longer term user. Our view has always been that potential for the industry is probably much larger than the forecast presently made would indicate, but we've never tried to quantify that as Exxon has now tried to do.

I think Exxon has done us a bit of a service, done us a real service, as to opening our eyes to the fact perhaps it is bigger than people are talking about. But we'll never know what we can do unless we get in and try it, so it ought to focus our attention on the larger objective and see what we can do under the conditions it can reasonably be done.

EXXON PROPOSALS FOR POTENTIAL OF SYNFUELS INDUSTRY

Senator HART. Would you individually or on behalf of your association be willing at the present time to endorse the Exxon suggestion? We can't call it a plan or proposal I guess.

Mr. HOPKINS. I can only give you my own view or that. I've been in the petroleum business now for a long time, the past many years that Exxon has been making petroleum forecasts. I've observed them and used them quite extensively and have come to have a great deal of respect for Exxon's ability to forecast. I suspect that they've made a very thorough study, and it's probably pretty well done. I have no basis, however, from any studies we've made to know whether we can agree that their numbers are right or not. They don't surprise us as they did you. They don't seem unreasonable. But that's about all we can say.

Senator HART. They don't seem unreasonable from what point of view? In terms of just technical ability to do it or financial ability to do it?

PROJECTIONS MAY PROVE ERRONEOUS WITH ADVENT OF NEW TECHNOLOGY

Mr. HOPKINS. From all points of view really. I think if you think back to the advent of other major new industries, take the aviation industry, if somebody had sat down in 1920 when it was just beginning to try to be formed and tried to forecast the level of activity at airports around the Nation, congestion of the airways and size and scope of the airports we're now using, I doubt they would have come anywhere near what we now have. I think we have that same problem when we look ahead at a new industry which is just trying to get started.

It's very difficult to forecast what improvements will be made, what new technology we will be able to find in environmental controls, and what innovations we'll have in the socioeconomic impact areas. I just believe that it's very hard to take the very limited amount of knowledge that we have today about an oil shale industry and project ahead. It takes a lot of imagination to do that to the size it probably really can get. That's what I mean by saying that. It seems reasonable.

Senator HART. Did you hear Mr. Thoem's testimony from EPA and/or see his exhibits?

Mr. HOPKINS. Yes, I heard his testimony. I couldn't see the exhibits.

Senator HART. What reaction if any did you have to the date that he presented on the air quality impact?

Mr. HOPKINS. Really I can't react to that, because I have not studied air quality impacts or modeling or dispersal of these emissions. I would only observe, like the other point I just made and the point that was made by Dr. House, all of those extrapolations are based on pilot plant data, emissions, based on the present state of the technology.

When we get a chance to work with the oil shale industry and get something built that we can at least have a sample to work with, then I think there are many things that we'll do to improve it. Whatever forecasts we make in the environmental areas today I suspect will turn out to be conservative; that is, we'll be able to do much better on the forecast based on present-day models.

NO SUBSTANTIAL AGREEMENT BETWEEN DOE AND EPA ON FEDERAL POLICY FOR OIL SHALE INDUSTRY

Senator HART. Dr. House, is there any substantial agreement between the Department of Energy and EPA over federal policy with regard to the development of the oil shale industry? Is DOE in the process of stimulating an industry that EPA says cannot be done?

Dr. HOUSE. Not that I'm aware of, sir. In fact more than that, we recently signed a memorandum of understanding with the Environmental Protection Agency to write jointly guidance documents which work through the various environmental problems that each one of the oil shale processes have and make sure a research program is in place and make sure there are no surprises. I'm not aware of any problems there.

Senator HART. What mechanisms does the Federal Government have, particularly the administrative branch, for coordinating its efforts and responses to development of a synthetic fuels industry? Is there an interagency council or cabinet level committee or anything like that?

Dr. HOUSE. I'm slowly but surely walking out of my department. There is an Energy Coordinating Committee which I know meets at the Secretary level at the White House.

Senator HART. Does the EPA sit in on that?

Dr. HOUSE. I think it does, yes, sir. At the research level, there are several research committees throughout the Department. There is an oil shale committee that meets. That's as far as I know.

Senator HART. Would each of you be available if we were to try to convene a hearing of this sort on the western slope in the next 30 to 45 days?

[Mr. Hopkins and Dr. House nodding.]

INDUSTRIAL DEVELOPMENT AND ENERGY DEVELOPMENT SOURCE OF GREAT CONCERN

Senator HART. I want to thank you and our other witnesses. As Mr. Pascoe said. I think there is great concern in this State and, as I said earlier, about industrial development and energy development. I know that for a fact. I've talked to the people. It isn't confined to the northwestern part of the State. It's throughout the Western Slope. It makes itself manifest here in the Front Range, even being discussed as a matter of conmern and particularly as a competitive water requirement interest for the farmers of the High Plains.

I think all of us that live here understand that we're on the threshold of something that the State has never seen before, potentially beneficial, potentially catastrophically destructive. As others have testified, Mr. Slick included, there is not one decision that has been made or will be made that will condition this industry. It will be dozens if not hundreds of Federal decisions, hundreds if not thousands of State decisions, thousands if not tens of thousands of local decisions. The real question is after all those decisions are made after 10 or 20, 30 years, what does Colorado look like? Is it worth living in? What's left after we've developed, some might say, plundered these energy supplies? More philosophically, will we use the energy wisely that we do develop? That's an even greater possibility.

It's one thing to develop energy, and it's another thing to waste it. Unless we develop an ethic in this country which permits us to use energy wisely, then I think it will all be for naught. And I think future generations will judge us cruelly and harshly but justly if we develop these supplies methodically or rapidly for wasteful purposes. And unless we can figure out as a people how to develop our energy and at the same time use it in the wisest way, I think we're going to have to answer to our children and their children.

The hearing is adjourned. Thank you all very much.

[Whereupon, at 12:20 p.m., the hearing in the above-entitled matter was closed.]

PACE OF OIL SHALE DEVELOPMENT

FRIDAY, AUGUST 29, 1980

U.S. Senate,
Committee on the Budget,
Rifle, Colo.

The committee met, pursuant to notice, at 9:55 a.m., at the Rifle Town Hall, Rifle, Colo., Hon. Gary Hart presiding.

Present: Colorado State Senator Dick Soash, Representative Carol Edmonds, Representative Nick Theos, Mayor Claude Schultz, Mayor Peggy Rector, Commissioner Tim Schultz, and Commissioner Flaven Cerise.

STATEMENT OF HON. MIKE KUNTUPIS, MAYOR PRO TEM, RIFLE, COLO.

Mayor Kuntupis. Good morning. On behalf of the city of Rifle, we'd like to welcome you to Rifle. My name is Mike Kuntupis. I'm the mayor pro tem of Rifle, Colo. Our mayor, George "Mitchel" had an accident and is recuperating. I'm taking his place today.

I'd like to introduce everybody on the panel if I may, Mr. "Wad" Hinman, who is State representative, will not be with us today. Carol Edmonds is our State representative from Mesa County. Nick Theos is our State representative. State Senator Dick Soash, our State senator. Over here is Mr. Tim Schultz. He's the county commissioner for Rio Blanco County, Peggy Rector, the mayor of Rangely. And Claude Schultz, the mayor of Meeker, Colo.

Again, I'd like to welcome you to our very crowded and very limited facilities. I don't usually do this. Someone told me I'm sort of politically naive. When I found out I would be doing the introduction for the U.S. Senator, Gary Hart, the first question I asked is: Is he a Republican or Democrat? And I asked a man on the street, and he thought he was George Bush's running mate. So maybe I'm not that dumb after all.

I would like to take one prerogative, if I may. I asked our city manager if we could do this, and he assured me I could. I know how the CIA and the FBI guys are, because I watch them on TV. I'm going to reach into my left jacket pocket, and all I'm going to do, fellows, is bring out a T-shirt to give to our U.S. Senator, Gary Hart. OK, here goes. This is our own design. It's "Rifle, Colorado, Oil Shale Capital of the World." And I'd like to present it to our U.S. Senator, Gary Hart, and welcome to Rifle.

Senator Hart. Thank you, mayor. I notice it's a small size. I don't know what that means.

Mayor Kuntupis. I made a mistake on the size. I will get you the proper size. Thank you.

OPENING STATEMENT OF SENATOR HART

Senator Hart. Thank you, Mayor Kuntupis. And we wish Mayor "Mitchel" a speedy recovery. ~~I'm very sorry to hear about his accident.~~

I would like to officially open this second in a series of two hearings which are basically designed to consider suggestions or ideas put forth by the Exxon Corp. with regard to synthetic fuels development in America with particular emphasis, of course, upon oil shale development and, to a lesser degree, the role that coal synthetic fuels might play in this region to meeting the country's future energy needs.

First of all, I'd like to begin by welcoming and thanking all of my colleagues here on the platform representing the State legislature, representing city government and county governments, particularly in this region who will be most affected by the inevitable development of our rich synthetic fuel resources here in Colorado. I'm so very pleased that so many of them could be here with us to participate in helping spread information to all of our fellow constituents and citizens of Colorado. I want to thank all of you for being here.

The hearing that we held several weeks ago in Denver I think was very helpful. It did get information out to the people of Colorado through the news media primarily. But I felt since this area particularly focused around the city of Rifle, it is the oil shale capital of the world and will be, and since this region of the State of Colorado and the Rocky Mountain West will be the most severely affected and benefited by the development of these resources that God has given us and because Colorado and this region now stands to be of such assistance to all of our fellow Americans in solving what I believe to be one of our most serious and critical problems, namely developing true energy independence and reducing as quickly as possible our dependence on foreign oil imports, it seemed to me only reasonable and just that a hearing of this sort be held here in Rifle. So I thank all those who have come from some distance to participate and particularly the representatives of Exxon.

AREAS OF INVESTIGATION

We will focus today as much as possible on three particular issues; one, the question of water supply and water availability for a synthetic fuels industry of whatever size; second, the potential effects of a synthetic fuels industry composed of both oil shale and coal development on the air quality of this region and the possible effect on other industry including our recreation industry; and third, the effect of a synthetic fuels industry in this area on the communities of this area. And that's why I'm particularly pleased to have community-elected officials on this platform.

I want to say that where the role of Exxon is involved, that I hope it's clear to all and particularly the representatives of Exxon that this is in no way an effort to be critical of or bring the weight or power of government down on the private sector and particularly this company. In many respects, I think Exxon is to be complimented for setting the stage, if you will, for the development of synthetic fuels in this country in the 1980's and 1990's. It is the ideas and the concepts that are important and the Exxon Corp. wishes its analysis of synthetic fuels not to be called a proposal. But these ideas and these concepts I think, obviously, bear serious consideration. And as the senior Senator of this State and as a member of two senatorial committees deeply concerned with the issue of synthetic fuels, the Budget Committee and the Environment and Public Workers Committee, I'm pleased that in putting forth these very sweeping ideas, this corporation has really focused public attention on the issue of Colorado's role in synthetic fuel development.

So with that I would like to welcome back again Mr. William Slick who testified before this hearing several weeks ago in Denver, senior vice president of Exxon Co., U.S.A.

Mr. Slick, if you would come forward and anyone who is helping you here today. I want to welcome you back. Particularly thank you for [illegible] time and trouble that you've gone to here to appear before this session of the Senate Budget Committee and this hearing. I know it's been at some inconvenience to you. And we have been in touch with your office and corporation and would like to request, if it is possible and given the time constraints that we have today, that you summarize to the best that you can the ideas on synthetic fuels that you and your company have come up with and focus as much as possible the summation of your remarks on those issues which we are gathered to discuss here today: water supply, air quality, and community impact.

Once that you've made that summary, then we'll open it up for questions of all of us here on this platform. Mr. Slick will be followed by panels representing both the State and Federal Government and private industry and citizen groups on the three topics of particular interest to us.

Thank you again, Mr. Slick. We look forward to hearing what you have to say.

STATEMENT OF W. T. SLICK, JR., SENIOR VICE PRESIDENT, EXXON CO., U.S.A.

Mr. Slick. Thank you, Senator. Just for the record, I am W. T. Slick, vice president of Exxon Co., U.S.A.

I really do appreciate the opportunity to come back here, because we are in the heart of oil shale country. This gives us an opportunity to, again, express to some people who have keen interest some of our views on synthetic fuels. And I think it's particularly appropriate in Rifle that has a long history and association with oil shale.

I must say, if you will permit the personal reference, when the Mayor pulled out his T-shirt to give to you, he kind of startled me for a minute. Because coming from Houston, I thought maybe we had another lovely blue T-shirt for the Houston Oilers, but we'll settle for the oil shale capital of the world.

Senator Hart. This will be produced in orange one of these days, I'm sure.

Mr. Slick. I'll let that one pass. As you know and as many of the audience know on August 1 we finalized an agreement whereby we became a 60-percent owner of the colony project and will be operator of that facility. It will be the first commercial oil shale facility in this country. And so we look forward to a long and very positive relationship with Colorado and particularly with people on the Western Slope.

I know you, Senator, and I suspect many in the audience, are familiar with the study we presented through reports in the media and through some of the communications meetings that we've been holding, particularly the one in Grand Junction this week. We submitted a copy of our paper for the record at the July 17 hearing you referred to.[1] And this morning I will make a few limited comments, summary-type comments, about that material to sort of put the rest of it in a little bit of focus and perspective. But mainly I do want to direct my attention as best I can to some of the questions which you presented to us in correspondence with our chief executive, particularly in the areas of water availability, air emissions, and community and socioeconomic impact which I think are really the thrust of this hearing.

I would underscore your opening comments that the study we presented is not an Exxon plan on how to solve the world's energy problems. It's not a description of Exxon's project. It's merely a result of planning studies that we have done, and we have done these studies over a number of years and made them public. This set of studies show the unique role for synthetics. Whether or not that role is achieved will be the result of decisions made by a large number of people over a long period of time including, I might say, a number of people who are in this room today.

The study also does not purport to be and does not represent a definitive engineering design or environmental impact assessment for a large-scale industry. What I think the study does is focus on the need to conduct studies to find out what those impacts are, find out how this thing fits into perspective. I would say that we are convinced that a major synthetic fuels industry can be developed in this country, and specifically an oil shale industry in this State, in such a way that we can meet the legitimate concerns of Coloradans and the energy needs of this country at the same time.

THE ENERGY TRANSITION

Just a few words about the study. As I indicated, it really is an outgrowth of the annual planning work that we do within my company on which we base our own company plans. We, being in the energy business, try to look and see what the energy situation is going to look like down the road. We conduct these studies. We've been publishing them for a number of years, and they provide the foundation, if you will, for our own corporate planning efforts.

Last year for the first time we extended the study out to the year 2000. We had been doing it to the year 1990. We came up with a real critical role for synthetics, and it led us to examine the question even further than the year 2000, because you have to ask yourself the question: Is the trip really going to be worth the pain? So we tried to go out to the year 2050 to see how this whole thing hung together.

They led us to conclude, the totality of this work, that this country and the Nation as a whole for that matter is in a state of transition in terms of energy. We're predominantly a petroleum-consuming country right now. We get 75 percent of our energy from petroleum. In the next century, that has got to change. We need to change the nature of conventional fuels. We're going to get some unconventional fuels. The United States and the world are going to have to get onto a base of renewable or nondepleting or extremely long-term resources. Because, quite frankly, we're running out of the conventional oil and gas. Even the Arab countries, the OPEC countries, have declining reserves. And we know they will see their own decline in the next couple of decades.

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[1] See p. 256.

U.S. ENERGY OUTLOOK

To get just a tad more specific than that, we see a tremendous surge in conservation in this country, and that's integrated and built into the studies we have put together. But in spite of that amount of conservation, we see that energy needs in this country are going to grow about a fourth by the turn of the century. In the 1980's and 1990's, if you think of it in a very macro or aggregate kind of sense, essentially all of that growth is going to have to come from coal and nuclear. And on balance, other forms of energy are really not going to grow very much during that period of time.

When you look out beyond the turn of the century, we still see energy continuing to grow, albeit at a slow rate. But when you grow at 1 percent a year over a long period of time, it aggregates up to quite a bit of energy. We see the economies of this country, and to some extent the world, shifting, as I said, to new kinds of energy, a very strong emphasis on more and more electricity. But when we looked into it, we found there was an irreducible minimum of needs that can only be met by fuels in liquid or gaseous form. These are transportation fuels and feedstocks for petrochemicals. We had to ask ourselves, "Where is that going to come from?" If you look at our country today—and we're using about 28 million barrels a day of oil equivalent in the form of oil and gas—if you put them together in terms of oil equivalent barrels, about 20 million barrels a day of that we get domestically and we import the other 8 million. By the year 2000, we think that total requirement will have shrunk to 25 million barrels a day as opposed to the 28 million. But domestic production will also have shrunk, and we'll be getting about 12 million barrels a day from domestic production, and that leaves 13 million to get from someplace else.

As we carried that trend on out, it tended to stabilize where we had a difference between what we can produce here domestically and what we need domestically in the form of gaseous or liquid materials of about 15 million barrels a day. And that need continues on out to the middle of the next century. There are only two ways that we can see that you can get it. You can import it, or you can try to get it from synthetic sources, because we just don't see the conventional material being there. We've already built into the analysis the maximum amount of shift to things like coal and nuclear that we think are feasible.

Well, I don't have to tell this group what the problems are of depending upon imports of that magnitude over that period of time. I think there's some question as to the physical availability, and we can all write our own mental scenario of what the political risks are and what the economic damage to this country is in continuing to go on importing to that degree.

SYNTHETICS INDUSTRY

The other alternative is synthetics. I'd say at the outset the long-term need did answer, as I suggested earlier, one fundamental policy question as I see it: Is the trip worth it? Is this something that you are going to need for a very short period of time, or is it something that you can carry on? We see it as a long-term need. There are a lot of other questions, a lot of other policy questions, a lot of other physical questions that need to be addressed. And we ran some of those. I'm not going to go on at great length. Some of the parameters we looked at were the resource base. Well, the amount of coal and oil shale you've got in this country convinced us there's plenty there so that you could produce 15 million barrels a day for 175 years and meet all the other needs that you have for coal in the process. And that 15 million barrels, as our study suggested, is about half and half oil shale and coal-based synthetics.

TECHNOLOGY

We examined the technology for synthetics, and we find in our judgment that there are a number of technologies for synthetic fuels that are ready for commercialization today. There are a number of them that apply to oil shale. They have been tested in large-scale pilot plants, if you will. And we think they're ready for expansion to commercial operations.

Following the first pioneer commercial-scale plants, we can see and we expect substantial improvements in the efficiency and investment economics as the technology matures. But our experience in the petroleum refining industry leads us to believe very strongly that the first efforts to build that first generation plant are not going to become obsolete as we develop new technology or as the new technology matures. You're merely going to absorb that new technology into the old plants; modify them, update them, and keep them kind of current.

The best example I can give you is the three major refineries we have in this country. One on the east coast and two on the gulf coast were built in 1908 and 1909, and they're still operating today. And over the intervening 70 years, they have changed substantially. We think that's what's going to happen in the oil shale industry or in the synthetic fuels industry. As the technology evolves, the plants will evolve with the change in technology.

CAPITAL

The next thing we looked at was capital, because if there's one thing characteristic about synthetic fuels, they're expensive. They're extremely capital intensive. If you look at a typical plant of 50,000 barrels a day oil equivalent, whether it's oil shale or coal liquids or gas synthetics, it turns out that on an as-spent basis, a plant like that costs between $3 and $4 billion. And when you do the quick arithmetic, when you're talking about a 15-million-barrel-a-day operation, that amounts to some $800 billion in current dollars or $3 to $4 trillion in as-spent money. And that at first blush is an extremely staggering amount of money. But I would point out a couple of things. One is that the capital markets in this country have demonstrated time and time again that if there is a viable investment opportunity, capital will be forthcoming to permit those investments to come on.

TIMEFRAME

And, secondly, we're talking about a 30-year period of time. We're not talking about something that's going to happen overnight. We've got a lot of details on this study that I'm not going to go into here. But I think it is important to recognize the timeframe that I'm talking about, because it gets to the heart of some of the questions that we discussed in Denver, Senator, and I know are deeply on your mind. We're talking about a 30-year period of time. The first synthetic plants of this country are not going to come onstream until the middle of this decade, 1985 give or take a little bit.

Our studies suggest that you can get up to 1 million barrels a day of total synthetics by 1990. These estimates are not inconsistent with the kind of numbers we see in the Energy Security Act for building a synthetic fuels industry in this country.

THE PACE OF OIL SHALE PRODUCTION

Since we're in Rifle, let's get more specific about oil shale: You have asked us specifically what we think will be the incremental steps and what do we think the buildup rate of the oil shale industry is going to be. Let's deal with the rate or the pace as you call it. First of all, if you look at the Energy Security Act, it calls for a production of 1.2 million barrels a day of oil shale in 1993. If you look at our projections, we've gotten to 600,000 barrels a day by 1990 and 1.5 million barrels a day in 1995. In other words, it's about the same kind of a rate as was in the Energy Security Act.

Now, to our knowledge there have not been very many people who have tried to carry an analysis beyond that time—to look beyond the early 1990's. And that's one of the fundamental things we did in our study. We tried to take a long view of this thing. And when we do that, our projection shows continued growth in oil shale up to 3 million barrels a day by the year 2000 and up to the ultimate level of 8 million barrels a day we described in the year 2010.

I think it's worth pausing a minute and thinking about those numbers. We're talking about a 30-year period of time. By the middle of that period, 1995, we'll have developed 20 percent of what we think is going to happen over the whole period. In other words, it starts off slowly, and the rate of development accelerates as experience grows and as you begin to build a base, and it can move forward. So the first 20 percent of production comes in the first 50 percent of the time, and the rest of the buildup comes on in the latter part.

IMPACT OF SYNTHETIC FUELS INDUSTRY ON NEED FOR IMPORTED OIL

Senator HART. Excuse me, Mr. Slick. What do you project by the year 2000 in terms of oil shale?

Mr. SLICK. Three million barrels a day.

Senator HART. I'm sorry?

Mr. SLICK. Three million barrels a day.

Senator HART. Do your projections also include any oil imports by the year 2000 if you were to follow this plan?

Mr. SLICK. By the year 2000, on the total United States, in a case where we had 6 million barrels a day of total synthetic oil equivalent—we had imports down to about 5.5 million barrels a day. So there are still imports in the year 2000, but they're coming down from the peak that we see of around 9 million barrels a day in the early 1990's, coming down to around 5 million in round numbers by the year 2000 and hopefully continue to go down. The case that we're talking about here, if you get up to the 15 million barrels a day synthetics by the year 2010, is the long sought after and much elusive total reliance on domestic sources that has been talked about for so many years.

Senator HART. But in spite of the fact we would have under this plan a synthetic fuels industry of 6 million barrels a day, we would still be importing around 5 million?

Mr. SLICK. Yes, sir. We're in the shape where, for whatever reasons, because of lack of attention to the problem over several decades, we've built up to where we're importing 8 plus million barrels a day. And by the same token, it's going to take us several decades to get off of that pattern and work it back down. It's not a problem you can cure overnight, and it's a tremendous problem as you well know.

Let me say at this point that I'm not really sure what's going to happen this afternoon or tomorrow morning, but I'm very bold in telling you what I think are in the cards for the year 2050. That's my way of saying, admittedly, the projections we're showing you have a lot of variability about them depending on how things come about. But the important thing is we think that if the Nation plans for a major synthetic fuels industry, it can have one. And the really important point is that when we start planning, we ought to not do it in such a way that prohibits us from having one. We ought to plan in such a way that if we want to go that route we can.

UTILIZING AVAILABLE RESOURCES

The other question you asked is one about incremental steps, how does the industry build up. The approach we're taking at the outset is to go to the room and pillar mining method with above ground retorts. We talked in terms of a nominal sized plant of 50,000 barrels a day, and that's what we put in this study. We think in the early years that's predominantly the way the industry is going to go. But as I was discussing with one of the panel members earlier, there's a real problem with efficiency of resource recovery when you go that route. Because room and pillar means you build a room but you leave a pillar of about the same size. So we're wasting a tremendous resource in this country; also you can't mine the full thickness of the deposit by room and pillar. Our studies therefore looked at the feasibility of major surface mines. We think in the long run if you're going to achieve this kind of an industry, you're talking about some significant surface mines. Nationally, we talked about 1 million barrel a day size of mines. Those are viable or feasible as we see it from an economic, from an engineering, from an environmental point of view. They're like the Bingham mine operation. And we're talking about a half a dozen of those to get this 8 million barrels a day.

Now, whether they're 50,000 barrels a day or whether the room and pillar mines go to 100,000 barrels a day and how retorts evolve as this technology evolves over a 30-year period, I'm not about to try to give the answers to that. For the purposes of the study we put together, we do believe that to achieve some reasonable and acceptable degree of efficiency in utilizing these resources the surface mining approach is one of the things we're going to have to do.

Senator HART. How big a mine is that for a million-barrel-a-day average?

Mr. SLICK. Oh, the pit would be about 3 miles long and 2 miles wide, and then it moves. It doesn't keep growing, it moves. t moves at the rate of about 600 feet a year, so it's moving at a very imperceptible rate. When you open it, you have to put some of the overburden on the surface. But then once you get it open and moving, as you retort the material, you're filling back in behind it. So that hole moves across the ground.

Senator HART. Six square miles?

INFLUENTIAL PARAMETERS OF SYNTHETIC FUEL DEVELOPMENT

Mr. SLICK. Yes. Not a small hole. As I say, it's the size of the Bingham operation. If you've flown over it, you know that's a pretty good sized operation. And these are numbers that the first time the fellows showed them to me, they had me kind of blinking. And it takes a while to get used to these kinds of things.

We looked at a number of other parameters in our study, parameters that we think are going to influence how this industry develops. But the three that I mentioned, the resources, the capital, and the technology, we don't think are going to be limiting. I have to say real quickly though that there are many ways in which government policy can make the resource question or the capital question limiting factors. if we don't have the right governmental approach at the Federal level to let these things take place.

The other parameters though are some of the ones in which you and members of the panel have expressed particular interest and I want to spend a fair amount of time on them. They have their counterparts in coal-based synfuels as well as in oil shale, I might say. These are water, infrastructure—and socioeconomic questions—and the environmental issues. And I might say something about the leasing policy since we all know the bulk of the oil shale potential lies under Federal land, and Federal leasing policies are going to be very important.

WATER AVAILABILITY

First, let me comment briefly on the water. I want to say before I begin that I'm not going to sit here and tell you we've done all the exhausting studies and we have all the answers. We haven't. We have a lot of questions. We think we've identified some things that really need to be plumbed. I want to identify or communicate to you what our current thinking is on some of these questions and where we stand.

The first one is water. There have been a number of studies done, including our own, that suggest that sufficient water from local sources—that is, western slope water—is available to permit the development of an oil shale industry through the late nineties that can get up to 1½ to 2 million barrels a day. The studies that I've seen range from 600,000 or 700,000 barrels a day up to 2 million barrels a day. And we think that the upper end of that range is not out of reason.

I say, just to give you a feel for whether we're being conservative or liberal or optimistic in our assessment, all of the technology studies indicate that it takes between 2 and 4 barrels of water to produce a barrel of oil shale. For the purposes of our study we assumed 3.6. Don't ask me to tell you why that was. But our studies were predicated on 3.6 barrels of water per barrel of oil shale. And that's constant throughout the 30 years. We don't think it's going to stay constant, but we wanted to test whether or not if it did stay constant this whole thing is reasonable. We think it's physically feasible. When you get beyond 1½ to 2 million barrels a day, you're going to have to go get some water someplace else.

Senator HART. But that's the break point?

Mr. SLICK. Yes.

Senator HART. In terms of local resources?

Mr. SLICK. In terms of western slope water, yes, sir.

INTERBASIN WATER TRANSFER

Senator HART. That's unappropriated water not now being used, or does that contemplate——

Mr. SLICK. As I understand, it's water not now being used.

The way to go beyond that is to go outside the area, interbasin water transfer as we mentioned. As our study suggests, we've looked at that. It's technically feasible from an engineering point of view and feasible from the economic point of view. We looked at bringing it from the Missouri River system in a major conduit systems, three large conduits; not in California type canals, if you will. It's a relatively small piece of the cost of oil shale. The kind of a facility we think could be built could have excess capacity in it to make water available locally. People are going to want some along the way; and additional water could be added to local supply, if you will, for municipal, agricultural, utility, and other efforts.

We recognize and we're extremely sensitive, I think, to the fact that there isn't any one question in the West that's more sensitive than water. We also feel that the question of interbasin transfers is not a new one. In fact it was really pioneered in this country, right here in Colorado. But any time you move water from one basin to another, you only do that after a long, difficult process of getting all the people involved and sorting out what the pressure points are. As we look forward to whether this is going to happen, it's going to take the involvement of a lot of people in all of the States that are affected and the communities that are affected. It's going to take the Federal Government, because we're going to be talking about an interstate movement of water if it comes about.

I said earlier that you have to plan now to accommodate a major industry if you really want to get there. Fortunately, in terms of water, if you need to go the interbasin route, our studies suggest you don't need that water until the late nineties. Now, to some that may seem a long way away. To somebody that's been working in the water field, you know what's not very far away. It takes time. But it's doable if we start now. I guess our basic posture is that the real challenge we face today is how we create the groups that can bring some action to the problem as opposed to just making further studies to define what the constraints are.

SOCIOECONOMIC IMPACT OF SYNTHETIC FUEL INDUSTRY

Let me turn to the second one you raised and that this panel is going to raise today, and that's infrastructure and social impact. As I indicated to you in Denver in July, Senator, we support the impact assistance legislation recently approved at the Federal level, the legislation that you have been intimately involved with. The Senate has approved some legislation. We have, since we talked to you last, commenced some efforts to try to get other groups, other industry groups, to consider or reconsider their positions on this kind of legislation. What our success rate is going to be, I don't know. You throw more weight than I do, and you know what kind of problems we have.

Senator HART. I wish it were so.

INFRASTRUCTURE DEVELOPMENT

Mr. SLICK. But we're working on the problem. I want to emphasize that while that assistance legislation is an important source of the funds for infrastructure development, most of the money, I think, that is going to be spent on infrastructure development, quite candidly, is going to come through existing channels; is going to come from both public and private source. A lot of private money is going to be involved here.

I think that many of the companies that are involved in synfuels are sensitive to and recognize their responsibility to help mitigate the socioeconomic impacts, the infrastructure problems that creating a new industry are going to bring about. Certainly, we are. Planning for these impacts and the creation of a required infrastructure is going to involve a lot of different constituencies, as you know as well as I, not just the producing companies but, more importantly, the people who are going to be affected at the local level, existing businesses, civic groups, governments at the local level, at the city and county and State level. I think there's a role in this whole question for academic institutions and other public and private institutions. We look forward to participating in that effort.

Our judgment is that it may even be necessary to create some new entities to try to coalesce some of these interest groups into working efforts that can deal effectively with the problem. Because as you know better than I, if we're talking about an industry that's primarily located on the plateau in the Piceance Basin, there are problems on the north side, on the south side, on the west side, on the east side. And all of those people are going to have to be involved in trying to figure out what kind of total system we put together.

HOME DEVELOPMENT FOR OIL SHALE EMPLOYEES

To get off of the big picture, grand scale, and to get a little bit more specific to some real world questions, you asked specifically whether or not we'd be willing to assist in financing homes for people working in the oil shale industry. And to be real specific about it, as you know, part of the Colony Project is the development of Battlement Mesa as a community down in Parachute. We have stepped into the Colony situation. We're going to be the operator. We have picked up that program, and we'll see that community developed. It's going to be developed by private funds and done in accordance with a master plan approved by Garfield County. Battlement Mesa is going to be what we term an open community. It's not going to be a company town. It's going to be an open community, and there are going to be people in there working in the oil shale industry. There are going to be people in there that are now living someplace else in the valley. It's going to be a community, not a company town. It's going to be some 3,000 acres. That's a pretty good sized spread. We think it will have over 7,000 dwelling units in it. It's going to include sites for churches, for schools, for commercial facilities, the things that are necessary to make a community go.

The plans call for a rather broad range of living units in terms of style and cost. We visualize a major open space system. We've had some experience with that in our developments in Texas, and some of those concepts are involved in this master plan. We anticipate that the dwelling units are going to be sold at prices prevailing in the marketplace. That community, the water, the sewer, the streets, the development of the raw land, the ultimate building of homes are going to be done with private capital.

We have no present plans to assist specifically in the financing of individuals trying to buy houses. We think that the nature of that community and the nature of the homes and the dwelling units that are going to be built will attract capital and developers and builders from the normal money markets in the home development area.

ENVIRONMENTAL ISSUES OF SYNTHETIC FUEL DEVELOPMENT

Now, the third point I want to turn to is the environmental issues.

Senator HART. I'm afraid we're going to have to ask you to summarize that as briefly as possible, because I think everyone will want to ask a few questions if we can.

Mr. SLICK. All right. We've done some work on the environmental question. As I said earlier, I don't suggest to you that we have all the answers. In fact we think one of the things that can be identified is we need to—when I say we, the communities as a whole—need to address them in more detail. We don't know of anyone, to our knowledge at least, that's done the fully detailed studies that are going to be necessary to gauge the impact or judge the impact of a large-scale industry on the environment. Baseline studies and impact work have got to get started now.

AIR POLLUTION CONTROL TECHNOLOGY

You asked us a couple of specific questions; one, have we any information that indicates air pollution control technology can be improved enough to avoid major violations of public health standards. And you also asked if we agree or disagree with the preliminary EPA estimates that existing technology would violate health and safety standards. Taking the last one first, pollution control technology that is going to be employed in the Colony project, and we believe will be employed in other early plants, will meet all existing environmental requirements. That plant has been permitted in conformity with environmental regulations to the best of my knowledge.

Furthermore, I would say categorically that the oil shale industry will only develop if it does in fact meet primary health and safety standards. And there are no data to suggest that the existing technology for processing oil shale, for mining and processing oil shale, does in fact violate primary health and safety standards.

IMPACT OF CHANGING INDUSTRIAL TECHNOLOGY

Now, the first of the two questions: If in fact a multimillion-barrel-oil-shale industry is to develop, the environmental impacts cannot logically be assessed by taking the data; the output, from one current plant of 50,000 barrels a day and extrapolating it into an 8-million-barrel-a-day industry. Rather, there would have to be studies made that really looked at the geography, the terrain, but more importantly to try to assess and take into account the changing technology in this industry. Because the process technology and the control technology are not going to be the same in 2000 or 2010 as they are today. You can't just take today's technology and extrapolate it that way by multiplication in the year 2010 anymore than you can go back 30 years ago to 1950 and take the average new 1950 automobile and what it discharged in the atmosphere and do the arithmetic and say that's what the situation is going to be in 1980. A lot's happened since 1950; a lot's going to happen between now and 2010.

LEASING SYSTEM

I said I want to comment quickly on leasing. The Federal leasing program for the Piceance Basin, like all the rest of the planning, has got to be geared to the long-term expectations if we're going to realize as a country our potential. A piecemeal approach just is not going to get the job done. Recently the Department of Interior has taken the initiative to expand the prototype oil shale leasing program and to try to structure a permanent leasing program. I think they are to be commended for that.

But if the oil shale industry is to develop consistent with anything approaching the scenario I've described, that permanent leasing system must be put in place within the next 2 or 3 years, and it's got to be done in such a way that it can accommodate the large-scale operation, the large-scale surface operation, that I described for the basin. We support one other initiative the Interior has taken, which is to try to do away with this limitation of 5,120 acres by one company and to allow some offsite disposal of material in the process of development.

LONG-TERM POTENTIAL OF SYNTHETIC FUEL DEVELOPMENT

Senator, I'm not going to make a long speech to wrap it up. I think our position is pretty clear. We see a lot of problems that need to be dealt with in a very explicit sort of way. Our purpose has been to hold out to this country—and I use that term both as the Nation and the western slope—hold out to this part of the country and the country as a whole, some idea of what the potential is. Whether we realize not something that Exxon is going to decide or, with all due respect, that you and I are going to decide. It's going to be the result of the accumulated decisions of a tremendous number of people, and I might even go so far as to say some as yet unborn. We're not talking about the fly-by-night operation that would be put in place in a couple of years and disappear in a couple of years. We're talking about something that's going to take at least 30 years to develop.

Our message is, the potential is there. It's a question of whether or not we've got the will to do it. And not trying to dramatize it, but we've said a a number of times and I say it again that we're really talking about the kind of commitment the likes of which we've never seen in this country in peacetime. If you think about that for a minute, you'll get a pretty good understanding of the magnitude of the problem as we see it, and the magnitude of the problem matches the potential that's there.

Now, I've tried to deal with a number of the questions you and the panel have raised in the process of going through this. I hope I haven't been too windy. I usually am. Two people get together, and Slick will make a speech. But I would be happy to try to deal with any other questions that you may have.

Senator HART. Thank you very much, Mr. Slick. I think your testimony has been very helpful.

Since we're already 10 minutes behind in terms of the next panel—but I'm sure everybody here on the platform has a question or two—I'll go around the platform and ask everyone to keep their questions short and the answers as well.

Representative Edmonds?

Representative EDMONDS. Mr. Slick, I'd like to ask you a question that I asked Monday in Grand Junction and hope I get a different answer.

Mr. SLICK. I don't know. whether I'll give you a different answer or not.

PREPAY COLORADO SEVERANCE TAX

Representative EDMONDS. What I asked, with our Colorado severance tax, as you know, that kicks in when the plant is one-half of design capacity. It would have a number of exemptions written in so the first 10,000 barrels would be exempt. So my concern is we won't be getting much severance tax until the plant is already onstream several years down, and we'll have a lot of construction impact before. I'm wondering if Exxon is in a posture to consider the prepayment of severance taxes, something that is allowed under Colorado law?

Mr. SLICK. Ms. Edmonds, one of the things clearly that you recognize is going to be necessary to develop an industry is front-end money in the infrastructure kind of area. And there are a number of ways that money can be developed. I don't believe that if you develop an 8-million-barrel-a-day shale industry, there's any way on God's green Earth you can do things at the front end that are necessary solely on the basis of the cash flow generated through state funds as you go along.

FRONT-END MONEY FOR INFRASTRUCTURE DEVELOPMENT ESSENTIAL

There are a number of vehicles through which that front-end money can come. One is prepayment of severance taxes you mentioned. Another is through bonding devices and guarantee of bonds. Another is through the expenditure of private funds. That's what we're doing at Battlement Mesa. So I'm not ready to jump on any one horse and say that yes, that's the way the front-end money is going to come, nor am I ready to dismiss it.

I think we have to work this problem as it unfolds and try to develop what kind of front-end money devices or vehicles are going to be the best ones to accommodate the needs. So the first thing you have to do is figure out where you're going and what are the needs. We stand ready to work with people that try to find ways to meet those needs.

To come in to say to the city of Grand Valley or Parachute today, "Really what we want you to do is go build a community so we can send 3,000 workers over here, we want you to build 7,000 housing units. Why don't you go build the streets and communities so we can get people started to work out here." That's ridiculous and we haven't done that.

We're trying to do something at the front end. I think the industry is ready to talk to people at the State, county, and city levels to try to work out these problems that are not limited to Parachute. We're not ready to dismiss any approach or jump on any one.

Representative **Edmonds**. May I ask one more question?

Senator **Hart**. Sure.

INFRASTRUCTURE DEVELOPMENT OF REGIONAL SERVICES AUTHORITY

Representative **Edmonds**. One other mechanism I noticed cited in an Exxon paper was for infrastructure development for the regional services authority. You didn't mention that this morning, but it was mentioned in the other Exxon paper. Can you describe to me what that company is thinking of when they mentioned that as a possibility for meeting socioeconomic impact needs?

Mr. **Slick**. Well, as I mentioned in my statement, we think there is probably going to be a need to coalesce some of the different views and points of views and working entities that can deal with some of these problems. Regional authorities have been used for a number of things around this country. Some of our earlier papers, as you suggest, even imply there may be one of those needed here. Let me give you a for instance.

If this thing develops to an 8-million-barrels-a-day industry, 7 million of which is basically right here out the window and up the hill, there are going to be people working up there— a large number of people working up there—and they're going to come from communities on the south side, the north side, the west side, and the east side. Somebody on a coordinating basis has got to deal with the transportation. And if you have dealt with any urban transportation systems, you know you don't develop them overnight. Some authorities of different kinds are going to have to be involved. I cannot conceive in my mind that you can leave to chance the question of how the workers get back and forth to work on top of Piceance Creek in an 8-million-barrel-a-day industry. You have to have some kind of an entity to deal with it.

It's in those kinds of questions, whether you're talking about transportation authorities or broader authorities than that, that there's going to be a real need for the input and I know a real desire to make an input on the part of local people, along with the State and county and company people that are all going to be intimately involved in that process.

Representative EDMONDS. Thank you.

Senator HART. Senator Theos.

THE COMPLEXITIES OF SYNTHETIC FUEL DEVELOPMENT

Senator THEOS. Thank you, Senator. I have a whole bunch of questions, and I'm not going to ask the same questions I did in Grand Junction, because you can't answer them, anyway. But I guess my question is: You know, we went through the oil boom in Rangely. We went through the uranium boom in Grand Junction and Rifle here and so forth, and we lived through it. We didn't ask the Government for impact money. We didn't ask for a lot of things. But I guess my question is, Why is it so complicated now? And you said there's a lot of answers you haven't got. Is it because of the new Federal laws you have to live under? Is it because most of the oil shale is in Federal land and you have to put up with Federal rules and regulations? Or is it because it's going to take a lot more people to develop oil shale than the other resources that we have?

Mr. SLICK. Well, the answer to your question is, yes, it's all of those things. This is a new technology. It's a much more complicated technology in some respects. It's an extremely capital-intensive kind of operation. The environmental laws under which we live today are much more complex than they were when the Rangely boom took place. The attitude of industry, the regulations notwithstanding, is that industry is not going to do things the way they did 30 years ago even if the people would let them, I don't believe.

We're really dealing with a major undertaking. It's been a will-of-the-wisp. It's been the elusive thing for people in this room who began to think about oil shale mining business in the 50's. I spoke to some of them before the meeting and I reminded them that it was President Hoover who took the Federal lands out of leasing. So this is something that goes back a long way, and it is complicated, Senator. There are no easy approaches.

And the morass of regulatory framework you have to climb through has not expedited things at all. We've got one facility—I forget exactly where it was—at last count where the guys told me. They had 160 permits they had to get for one operation.

Representative THEOS. I guess I'll waive the rest of my questions to the Senator.

Senator HART. Senator Soash.

FINANCING FOR WATER IMPOUNDMENT FACILITIES

Senator SOASH. I thank you, Senator.

Actually, Representative Edmonds stole my first question. In light of that, I hope you will give some consideration for the provisions passed in the State legislation. Let me say that, in credit of the energy industry generally, by experience has been that the energy industry comprises some pretty responsible corporate citizens.

I want to ask you a couple of questions on water. First of all, the figures you had on water, did they take into account the building of any storage? Does that include construction of storage projects and stored water which now goes downstream?

Mr. SLICK. It's my understanding that, yes, there has to be some impoundment facilities. I can't give you chapter and verse, but it's my understanding, yes, to get that spring runoff.

Senator SOASH. How did you assume those would be financed—through Federal dollars or State dollars? How did you see them to be financed.?

Mr. SLICK. I don't think we necessarily made an explicit assumption throughout this large industry. And some of the individual projects with which we've been dealing in other parts of the West, we have acquired over a long period of time water rights, and we envisioned having to expend some funds to develop those water rights. The water is going to be sold, if you will. The water that's developed in these water rights is going to be sold. And the selling of that water is going to pay for the effort.

Now, whether there are water distriicts that get bonded and indebtedness gets paid off through water charges or what, we haven't worked that whole master plan out. But those are the kind of specific things that need to be dealt with. We're not talking about, in our judgment, the public sector having to swallow the cost of creating the facilities to provide the water. We're talking about the industry paying its way on the water. Just like bringing this water down—we would visualize we would pay for that water.

Senator SOASH. We do have a bending mechanism at the State level that allows you to do that. Do those estimates include increased domestic demand created?

Mr. SLICK. Yes.

Senator SOASH. The other thing, what flow does this presume on the Colorado River, the historical flow over the last few years? Or does it presume the flow outlying in the compact?

Mr. SLICK. We work our study by looking at the demand side of what we thought was going to be necessary. On the supply side we looked at the studies that were made available by others, one of which was the State's preliminary studies in 1979 on water availability. So we've looked at other people's work on what's available and our people's work on what's needed. And when we did that, we got a match.

Senator HART. Mr. Cerise?

EXXON LAND HOLDINGS

Commissioner CERISE. Senator Soash stole my question. I guess it pays to be at the head of the line. Do you own any more land or would you consider enlarging that? Are there any plane?

Mr. Slick. I cannot answer you, Commissioner, as to whether we own more land. If the living units in Battlement Mesa went like hotcakes and got filled up in a hurry and we saw further need, yeah, we'd look at what's the next step. We don't look at this as the be all and end all. We look at this as a facility that's adequate to accommodate the Colony situation. As I said, we're not looking at something that will just handle the workers in the Colony project. We visualize this as being an open community that will have other people in it. Yes, we're not adverse to looking at other things. The people who will be running the Battlement Mesa as a development for us are people that come from our affiliate that's in the land development business. That's their business, their everyday stock in trade.

Senator **Hart.** Commissioner Schultz?

COST OF SOCIOECONOMIC IMPACT ON AREA

Commissioner **Schultz.** Thank you, Senator. I have two questions for Mr. Slick. First, I think I took the right notes. You said it would cost $3 to $4 billion to build one plant to produce what?

Mr. Slick. 50,000 barrels.

Commissioner **Schultz.** That cost them——

Mr. Slick. The Colony plant is not going to cost quite that much, because we got started a while ago and we're not going to have as much inflation involved as will supplemental plants, because we got started a little earlier.

Commissioner **Schultz.** Of that cost, what percent or what cost figure do you have in that as the cost for socioeconomic impact and mitigation type measures?

Mr. Slick. I can't give you that number specifically that way, but I would say to you that it's not a major piece of it. But it's adequate to do the kinds of things that we're doing at Battlement Mesa.

Commissioner **Schultz.** Is 1 percent, 2 percent a reasonable figure?

Mr. Slick. Commissioner, I'll get you a number, but I'm not going to sit here and guess with you, because that's all I would be doing.

ROAD CONSTRUCTION

Commissioner **Schultz.** I would appreciate seeing what you have in those figures. One other question that I have involves the transportation network. And we're faced in Colorado with a shortfall on our highway funding with counties having trouble raising moneys with 7-percent tax limitations. Would you see that industry would have a participation or an area where they could participate in the construction of roads leading into and out of the oil shale area?

Mr. Slick. Well, I think the answer to that is pretty much similar to the discussion I had with Ms. Edmonds earlier. We recognize there are going to be some things that are going to have to be done at the front end. And somehow or another between the industry and local governments, we're going to have to find ways to get those done, ways that can accommodate both of our needs. I think it's unreasonable for an industry to come in and talk in the kinds of numbers I've talked about and turn to the local communities and say, "You do it." That's preposterous, and we recognize that.

What the vehicles are, Commissioner, I'm not prepared to tell you. I am prepared to tell you that we are prepared to be part of the communities in which we're going to be involved. I mean that in the full sense of that term. And that means we're going to have to be involved in planning, in sorting out some of these problems in the front-end planning, and I suspect some of the financing. But I don't know what the vehicles are going to be.

Commissioner **Schultz**. Thank you.

Senator **Hart**. Peggy Rector?

SUPPLY EXXON REPRESENTATIVE TO ASSESS MUNICIPAL NEEDS

Mayor **Rector**. You asked some things that I was going to ask, too. I would ask at this point—I see the municipal needs as having someone from industry work directly within the community. I think you have to be there to know the situation. And I would ask if your company plans to have those people available to the communities which you will affect?

Mr. **Slick**. The best way I can answer that——

Mayor **Rector**. Such as an impact board——

Mr. **Slick**. The best way I can answer that is to tell you that the man who is going to be responsible for building Battlement Mesa is in the house hunting business right now. He's trying to find a home in the valley someplace. The man who's going to be responsible for building the Colony mine is in the home hunting process and trying to find a place to live someplace in the valley. We are most anxious to get people on the ground. You cannot run this kind of an operation from Denver or Houston or someplace else. You have to get out here, and you have to ge involved.

We look with some pride on the fact that in communities where we have been in operation over a period of time, if you look around you, you find people on the school board, people in the civic clubs, people in volunteer organizations that are Exxon employees. These people are going to be part of the communities in which they're involved. And our management people, some of them are going to be out here, and parts in some of this planning process.

I agree with you that we need more people on the ground. The circumstances of where we stood and how the Colony thing came about and how this matter unfolded just made it where we couldn't do it any quicker than we're doing it. I wish we had somebody out here a long time ago, but I also wish we had some oil shale resources we could have developed some time ago.

Mayor **Rector**. I would like to make one statement. You say by 1990 you can have some things on the line. I would hope that you would be able and we all would be able to do much better than we're doing now. Because if Rangely, Colo., cannot get a plant at 800 mekawatt units sitting in Colorado as opposed to Utah because of some of our regs, I really don't believe that you all can come on line before you're talking about in 1990, in the short measure you're talking about. I think we ought to review where we are. I agree with you that we need to get on with things for the nation as a whole.

Senator **Hart**. Mayor Schultz?

WASTE WATER DISPOSAL

Mayor SCHULTZ. On this amount of water it takes for a barrel of oil, will there be any waste water?

Mr. SLICK. I'm not really sure what you mean by waste water. If you're talking about is there going to be dirty runoff water, the answer is "No."

Mayor SCHULTZ. What are you going to do with your——

Mr. SLICK. Most of the water is consumed in one of two ways, either in cooling or in wetting down the spent oil shale in such a way you can manage it and manage the dust problems. The disposal plans that I've seen for the surface mine operations are conceptually ones that you put the material down, you put it down wet, you put it down on a seal so the water doesn't percolate down. Then you make provisions as water runs off, if it does run off when you get snow melt or whatever, you catch it and it goes back into this wetting process. But we're contemplating a system that does not end up with a lot of runoff water from these facilities.

DISPOSAL OF WASTE MATERIAL

Mayor SCHULTZ. And you have gotten a place for your waste material?

Mr. SLICK. To my understanding, yes, we have. The Colony project is on schedule with its permitting. And the permitting covers how we're going to dispose of waste material. Disposal of waste material, of spent shale, is not a minor problem. It's a major problem. And in an industry of this size, it's going to be one of the big problems, and it's going to have to be managed. We're committed to managing it. When I say managing it, I don't mean we're committed to the way of managing it to the least cost to us. We're committed to managing it in a way that meets the needs and requirements of the area.

GUARD AGAINST POTENTIAL ADVERSE EFFECTS OF OIL SHALE INDUSTRY

Senator HART. Mr. Slick, just a couple brief comments to which you may or may not respond. We are today focusing on so-called constraints. And I think one of your colleagues, Mr. Oennstedt if I have the name right, in the public briefing in Grand Junction said we have to focus less on the constraints and more on getting on with it, a little along the lines of what Mayor Rector was saying.

It seems to me the analogy of that in recent terms would be to say in terms of rescuing the hostages, the Joint Chiefs of Staff have said to the Navy, "We don't care what the range or limitations of your helicopters are. Just send them in." Focusing on your constraints is what it's all about.

We had an experience in this country where there were no barriers and no constraints, and a resource was developed. We're still paying costs on it. That was the coal boom in Appalachia. It's easy, I think it's easy to develop this oil shale. I really do. I think the capital is there. I think the technology is there, I think your corporation and the oil and gas industry in this country has the wherewithal and the resources—technologically and financially. The question is: What is left behind? I think we have to get on with it, too, but I think we have to know what we're doing.

This is the latter part of the 20th century and not the 19th. I don't want my children to live in a State that looks like Appalachia, and I don't think anyone else does here. So if we'll limit and reduce the constraints, the permits and licenses, I think we ought to know what we're doing as much as humanly possible. I don't think most people in this State would disagree with that. It's just a question of where the limitations and the constraints are going to be placed and whether they're going to be reduced.

The other thing is I am very troubled by your statement that——

Mr. SLICK. Senator, could I comment on your first point?

Senator HART. Yes. Please, go ahead.

Mr. SLICK. First, Mr. Dennstedt I think was paraphrasing something I said in Denver and something I said here and that is that we think the need is to try to begin to work the problem, not try to find out how we can put in more road barriers and make the problem worse. And I don't really think that is inconsistent with what your own posture is. You said several times that you think we ought to get on with development of the program. When I say not focus on constraints, I do not in any way mean to imply that it's either the view of my company or myself that the oil shale industry should be turned loose to do as it darn well pleases. I'm talking about an industry that's going to develop within the system, the regulatory and permitting and legislating system, that is out there today. And it's a lot different than the one that was in existence at the time of some of the prior booms that have been alluded to and referred to here this morning.

We are prepared to be a major factor in the synthetic fuels industry, and we are prepared to be responsible citizens in the communities with which we come into contact. And we're not talking about anything that's going to take Coloradans kicking and screaming into a major oil shale industry, because I don't think the world works that way anymore.

ELIMINATE LONG-TERM RELIANCE ON IMPORTED OIL

Senator HART. The other observation has to do with the related issue of the national security and that influence. The reason I support an oil shale industry as much as anyone else is I'm afraid of war in the Persian Gulf. I don't think 20 years from now getting our import level down to 5 or 6 million barrels a day is enough. It particularly concerns me that if we undertake the investment, both financial, ecological, environmental, in a major synthetic fuels industry in America with its central focus on the ground that we sit on now, that results in 6 million barrels a day by the year 2000 and we're still importing 5 to 6 million barrels, we've gone far enough or we've done enough. And I think even if we went the 6 million barrel target route by the year 2000, we're going to have to go some other way to reduce those imports down even much below 5 million if possible.

I don't know what that does to Exxon's or other major foreign producers' strategy, but I'm concerned about that continued reliance two decades from now on that level of imported oil.

DEVELOP ADDITIONAL ALTERNATE ENERGY SOURCES

Mr. SLICK. Senator, I would comment that my company and many in the industry of which I'm a part have spoken about concerns over the national security in the context of energy policy for two or more decades. I personally have been involved in some of that aspect of the business for at least that period of time. And our concern has always been that national policy needs to recognize the long-term interests of this country. Quite candidly, we were concerned then, we're concerned now, that the shortsightedness of some policymaking, long before you got involved in government, in the 1940's and 1950's, the shortsightedness of some people in being interested in the lowest cost solution to our energy needs are part of what got us in the tight spot we're in right now. We fought against that. We were pilloried for fighting against it on the basis that we were fighting for our own self-interest. We weren't. We were arguing for the self-interest of our country. And we feel just as strongly about it today as we did then.

I'm not comfortable at all about the fact that it takes a gargantuan effort and takes 6 million barrels a day of synthetic fuels by the year 2000 and you still have to import 5 a day. I am most uncomfortable with the degree of dependence we have on foreign sources. What my message is to you is that compared to what we were doing as recently as 5 or 6 years ago, 8 years ago, 1972, by the year 2000 we'll be using 27 million barrels a day less energy than we would if we were still going on the path we are going on. Gasoline consumption in this country by the year 2000 by our estimates will be down to 4½ million barrels a day. We used 7½ million barrels a day last year. And we still see this need for other sources of energy beyond coal and nuclear and domestic oil and gas. And the only way we know to get it is to import it or to try to do what this country has always done, come up with another way to do something.

Difficult? Yes. Expensive? Yes. But there is another way to do something. And the other way as we see it is synthetics. And that in our judgment is a policy decision that this country has got to deal with. Do we want to make the commitment that is necessary to get there? This country wants to do better, and we want to be a part of it. We're trying to hold that picture out, a specter if you want to call it that, because I think that's what it is. I think that's what you think it is. The specter of this country being dependent at the turn of the century for anything even approaching 10 or 15 million barrels a day in imports, that scares the hell out of me to be quite frank about it.

Senator HART. It's totally unacceptable. I want to thank you again for coming up here. Again, as I said at the outset, your company's putting forward this concept is very beneficial. I think your willingness coming out here twice and sharing your ideas and their ideas with us is particularly helpful, particularly this hearing today.

Mr. SLICK. Senator, we look forward to hearing some of the other comments throughout the day. Thank you.

Prepared Statement of W. T. Slick, Jr., Senior Vice President, Exxon Co., U.S.A.

My name is W. T. Slick, Jr., Senior Vice President of Exxon Company, USA. I appreciate this opportunity to come to the heart of the oil shale country and express Exxon's views on the subject of synthetic fuels. It is particularly appropriate that this hearing is being held in Rifle, where much of the pioneering work on oil shale was done.

As you know, on August 1 Exxon finalized an agreement whereby we became a 60 percent owner and the operator of the Colony Project, the first commercial shale oil facility. Thus, we're looking forward to a long and positive relationship with the people of Western Colorado.

I know you, Senator, and I suspect many in the audience, are familiar with our synthetics study either through reports in the media, or from attending a communications meeting held in Grand Junction this past Monday. A copy of that paper was made part of the Committee's record of the July 17 hearing in Denver. This morning, I will only make a few summary comments on its substance. Most of my comments will be directed to some questions, which were recently raised by the Chairman and other interested individuals here on the Western Slope, particularly in the areas of water availability, air emissions and community impact.

But first, I feel compelled to set the record straight regarding this study. We are pleased our paper has stimulated the process of public debate.

UNFORTUNATELY SOME HAVE MISUNDERSTOOD BOTH ITS PURPOSE AND ITS MESSAGE. IT DOES NOT CONSTITUTE "EXXON'S PLAN," AS SOME HAVE CHARACTERIZED IT, FOR SOLVING THE COUNTRY'S ENERGY PROBLEM. NOR DOES IT OUTLINE A MAJOR PROJECT UPON WHICH EXXON IS EMBARKED. IT IS, QUITE SIMPLY, OUR ASSESSMENT OF THE EXTENT OF THIS COUNTRY'S FUTURE ENERGY NEEDS AND WHAT WE BELIEVE IS POSSIBLE SHOULD THE COUNTRY CHOOSE TO TAKE ADVANTAGE OF ITS TREMENDOUS POTENTIAL FOR SYNTHETIC FUELS.

MOREOVER, THE STUDY DOES NOT REPRESENT A DEFINITIVE ENGINEERING DESIGN OR ENVIRONMENTAL IMPACT ASSESSMENT FOR A LARGE SCALE SYNTHETIC FUELS INDUSTRY. EACH OF THESE WILL REQUIRE SUBSTANTIAL ADDITIONAL EFFORT. HOWEVER, IT DOES CLEARLY IDENTIFY A NUMBER OF KEY AREAS THAT REQUIRE FURTHER STUDY BY FEDERAL, STATE AND LOCAL GOVERNMENTS, AND BY THE PRIVATE SECTOR. WE ARE CONFIDENT THAT WITH A COOPERATIVE EFFORT, PROBLEMS SO IDENTIFIED CAN BE RESOLVED IN A MANNER THAT BALANCES THE LEGITIMATE CONCERNS OF COLORADOANS WITH THE ENERGY NEEDS OF THE NATION.

THE ENERGY TRANSITION

TURNING NOW TO OUR STUDY, AS AN INTEGRAL PART OF OUR BUSINESS PLANNING EFFORT, EXXON PREPARES ANNUALLY AN ENERGY OUTLOOK. FOR A NUMBER OF YEARS, WE HAVE MADE THOSE OUTLOOKS PUBLIC. LAST YEAR, FOR THE FIRST TIME, WE EXTENDED THE OUTLOOK TO THE YEAR 2000. THIS LATEST OUTLOOK SHOWED A SIGNIFICANT ROLE FOR SYNTHETICS IN AMERICA'S FUTURE.

TO BETTER UNDERSTAND THAT ROLE AND TO TEST ITS LONG-TERM VIABILITY, WE EXTENDED OUR ASSESSMENT TO THE YEAR 2050.

THESE STUDIES HAVE LED US TO CONCLUDE THAT THE UNITED STATES, AND IN FACT THE WORLD, ARE IN THE EARLY STAGES OF AN INEVITABLE ENERGY TRANSITION FROM A PRIMARILY PETROLEUM-DEPENDENT ECONOMY TO AN ENERGY-DIVERSIFIED ONE WHICH WILL EVENTUALLY BE MORE RELIANT ON NONDEPLETING FUEL SOURCES.

- FOR SEVERAL YEARS, THE UNITED STATES HAS BEEN PRODUCING DOMESTIC PETROLEUM RESERVES FASTER THAN THEY ARE BEING DISCOVERED. EVEN THE MAJOR OIL-EXPORTING NATIONS OF THE MIDDLE EAST, WHICH HAVE THE GREATEST KNOWN PETROLEUM RESERVES, WILL BEGIN TO HAVE THEIR OWN PRODUCTION DECLINES WITHIN THE NEXT TWO-THREE DECADES. AND WE KNOW THAT SOMETIME IN THE NEXT CENTURY, THE WORLD WILL HAVE TO RELY SUBSTANTIALLY ON NONDEPLETING OR RENEWABLE ENERGY SOURCES.

U.S. ENERGY OUTLOOK

TO GET MORE SPECIFIC, WE PROJECT THAT EVEN WITH SIGNIFICANT CONSERVATION, TOTAL DEMAND FOR ENERGY IN THE U.S. WILL GROW BY ABOUT ONE-FOURTH BY 2000. IN THE 1980S AND 1990S, ALL OF THE GROWTH IN DEMAND FOR ENERGY WILL BE SATISFIED BY COAL AND NUCLEAR.

IN THE 21ST CENTURY, THE DEMAND FOR ENERGY WILL CONTINUE TO GROW SLOWLY. NONDEPLETING ENERGY SOURCES, SUCH AS SOLAR AND NUCLEAR FUSION, WILL MAKE INCREASINGLY LARGE CONTRIBUTIONS AS MORE AND MORE ENERGY IS CONSUMED AS ELECTRICITY. THERE WILL, HOWEVER, BE LARGE SEGMENTS OF DEMAND--PRIMARILY IN THE TRANSPORTATION AND PETROCHEMICAL AREAS--WHICH CAN ONLY BE MET BY LIQUID AND GASEOUS FUELS OR FEEDSTOCKS. WHILE WE EXPECT THE DEMAND FOR OIL AND GAS TO GRADUALLY DECLINE, THE ABILITY OF THE U.S., AND EVENTUALLY THE WORLD, TO PRODUCE OIL AND GAS FROM CONVENTIONAL SOURCES WILL DECLINE FASTER.

TODAY, THE NATION'S DEMAND FOR OIL AND GAS TAKEN TOGETHER IS ABOUT 28 MMB/DOE, OF WHICH ABOUT 20 MMB/DOE IS FROM DOMESTIC PRODUCTION WHILE 8 MMB/DOE IS SUPPLIED BY IMPORTS. BY THE YEAR 2000, WE ESTIMATE DEMAND FOR OIL AND GAS WILL HAVE DECREASED TO ABOUT 25 MMB/DOE. BUT DOMESTIC PRODUCTION WILL BE ONLY ABOUT 12 MMB/DOE, LEAVING A DIFFERENCE OF 13 MMB/DOE. EARLY IN THE NEXT CENTURY, THIS DIFFERENCE BETWEEN DEMAND AND DOMESTIC PRODUCTION COULD GROW TO ABOUT 15 MMB/DOE AND COULD CONTINUE AT ABOUT THAT LEVEL UNTIL THE MIDDLE OF THE CENTURY. CLEARLY, THESE PROJECTIONS ARE SUBJECT TO VARIATION. THE ESSENTIAL POINT IS THAT FOR MANY DECADES TO COME, THERE WILL BE A LARGE DEMAND FOR ENERGY IN LIQUID AND GASEOUS FORMS WHICH CANNOT BE SATISFIED BY DOMESTIC PRODUCTION OF CONVENTIONAL OIL AND GAS.

THIS 15 MMB/DOE WOULD HAVE TO BE COVERED EITHER BY IMPORTS OR BY SYNTHETICS. I DON'T THINK I NEED TO REMIND ANYONE OF THE UNCERTAINTIES THAT SURROUND THE SUPPLY OF IMPORTED OIL, EITHER FROM POLITICAL FACTORS IN THE NEAR TERM, OR THE PHYSICAL CAPABILITY LONG TERM TO MEET OUR ESSENTIAL NEEDS.

AS FOR THE APPROACH, THE LONG TERM NEED WE HAVE IDENTIFIED ADDRESSES THE IMPORTANT POLICY QUESTION OF WHETHER THE VERY LARGE COMMITMENT OF RESOURCES NECESSARY TO DEVELOP A MAJOR SYNFUELS INDUSTRY WOULD BE WORTH IT. CLEARLY WE BELIEVE IT IS.

SYNTHETICS INDUSTRY

HAVING THUS ESTABLISHED A LONG-TERM NEED FOR SYNTHETIC FUELS, WE NEXT ASKED OURSELVES HOW LARGE AN INDUSTRY COULD BE DEVELOPED AND WHAT WOULD BE REQUIRED. TO ADDRESS THAT PROBLEM ONE HAS TO EXAMINE SEVERAL KEY QUESTIONS. FIRST IS THE MATTER OF RESOURCES. WITHOUT GOING INTO DETAIL, SUFFICE IT TO SAY THE U.S. IS BLESSED WITH ENOUGH COAL AND OIL SHALE TO PRODUCE 15 MMB/DOE OF SYNFUELS FOR 175 YEARS-- 8 MMB/DOE OF OIL SHALE AND 7 MMB/DOE OF COAL SYNTHETICS.

SECOND, WE EXAMINED SYNTHETIC FUELS TECHNOLOGY. WE FOUND THAT A NUMBER OF PROCESSES ARE NOW READY FOR COMMERCIAL APPLICATION WHILE OTHERS ARE STILL IN THE RESEARCH AND DEVELOPMENT STAGE. SPECIFICALLY WITH REGARD TO OIL SHALE, SEVERAL SURFACE RETORTING PROCESSES HAVE OPERATED SUCCESSFULLY IN LARGE PILOT PLANTS, AND THE TECHNOLOGY NOW IS READY FOR SCALING UP TO COMMERCIAL SIZE.

FOLLOWING THE FIRST PIONEER COMMERCIAL SIZE PLANTS, WE CAN EXPECT IMPROVEMENTS IN OPERATING EFFICIENCY AND INVESTMENT ECONOMICS AS THE TECHNOLOGY MATURES. BUT EXPERIENCE IN PETROLEUM REFINING HAS SHOWN THAT THE FIRST GENERATION PLANTS DO NOT BECOME OBSOLETE AS TECHNOLOGY EVOLVES. RATHER, THEY ARE MODIFIED, UPGRADED AND MADE MORE EFFICIENT THROUGH INCORPORATIONS OF THAT CHANGING TECHNOLOGY. THUS, GIVEN THE COUNTRY'S OBVIOUS NEED FOR SYNTHETIC FUELS PRODUCTION, WE ANTICIPATE THAT SECOND GENERATION PLANTS WOULD BE IN DESIGN AND EVEN CONSTRUCTION AS THE FIRST ROUND OF PLANTS COMES ONSTREAM. WE SEE LITTLE TO BE GAINED AND MUCH TO BE LOST BY ARBITRARILY DELAYING THAT PROCESS.

THIRD, WE EXAMINED WHETHER ENOUGH CAPITAL COULD BE RAISED TO BUILD A LARGE SYNTHETIC FUELS INDUSTRY. COMMERCIAL SIZE SYNTHETIC FUELS PLANTS WILL BE EXPENSIVE. WE ESTIMATE THAT A TYPICAL 50,000 BARRELS OF OIL PER DAY PLANT WOULD COST \$3 TO \$4 BILLION "AS SPENT" DOLLARS. THE INVESTMENT REQUIRED TO ATTAIN A PRODUCTION LEVEL OF 15 MMB/DOE IS IMMENSE--OVER \$3 TRILLION "AS SPENT" DOLLARS. DESPITE THE MAGNITUDE OF THE INVESTMENTS REQUIRED, WE BELIEVE THEY ARE MANAGEABLE. THE CAPITAL MARKETS HAVE DEMONSTRATED TIME AND AGAIN THAT GIVEN SOUND INVESTMENT OPPORTUNITIES, THE NECESSARY CAPITAL IS FORTHCOMING. AND THESE CAPITAL DEMANDS WOULD BE SPREAD OVER A 30-YEAR PERIOD OR MORE.

It is important to recognize the time frame for the development of a synthetic fuels industry. The first plants will not come onstream until the mid-1980s. Several studies estimate that the level of synthetic fuels production in 1990 will be about 1.0 MMB/DOE. These estimates seem consistent with reaching or coming close to the national goal of 2 MMB/DOE of synthetic fuel production in 1992 as embodied in the recently passed Energy Security Act.

Looking specifically at shale oil, you have asked about the likely incremental steps and pace. First, as to pace, the Energy Security Act calls for a production level of 1.2 MMB/D in 1992, which is in line with our projection of 600 thousand barrels a day in 1990, building to 1.5 MMB/D in 1995. To our knowledge, few, if any, have really tried to take the problem beyond the 1990 time frame. However, we have extended our analysis to the middle of the next century. We project a continuing buildup to 3.0 MMB/D in 2000 and ultimately to 8.0 MMB/D in 2010. It is worth noting that under our scenario, production builds slowly in the early years, with less than 20 percent of the ultimate volume being reached by the halfway point of the 30-year buildup time.

ADMITTEDLY, THERE ARE MANY UNKNOWNS ABOUT THE ULTIMATE PRODUCTION LEVELS OF SHALE OIL AND OTHER SYNFUELS. WE BELIEVE IT IS IMPORTANT, HOWEVER, THAT AS THE NATION PLANS FOR SYNTHETIC FUELS DEVELOPMENT, WE DO SO IN A WAY THAT DOES NOT PRECLUDE ACHIEVING OUR FULL POTENTIAL, WHATEVER IT MAY BE.

TURNING TO YOUR QUESTION ABOUT THE INCREMENTAL STEPS, WE BELIEVE THAT THE OIL SHALE INDUSTRY WILL START WITH PRIMARILY WITH ROOM AND PILLAR MINING OPERATIONS AND SURFACE RETORTING. WHILE IT MUST BE RECOGNIZED THAT THE ACTUAL SIZE OF THE INDIVIDUAL PLANTS WILL VARY, WE USED A 50,000 BPD PLANT FOR ILLUSTRATION PURPOSES. LONGER TERM, LARGE SURFACE MINING OPERATIONS WILL LIKELY BE UTILIZED. AGAIN, FOR ILLUSTRATION PURPOSES, WE PROJECTED SIX 1 MMBPD SURFACE MINING PLANTS. NOTIONALLY, THIS SUGGESTS 46 PLANTS--40 AT 50 MBD AND 6 AT 1 MBD--TO REACH 8 MBD. IT WOULD BE A MISTAKE, HOWEVER, TO PUT UNDUE EMPHASIS ON THE NUMBER OF PLANTS: THE RATE OF BUILD-UP IN PRODUCTION IS THE KEY FACTOR.

IN OUR STUDIES, WE HAVE LOOKED AT MANY PARAMETERS THAT WILL INFLUENCE THE ULTIMATE SHAPE AND SIZE OF A U.S. SYNFUELS INDUSTRY. WE BELIEVE THE ONES I HAVE ALREADY MENTIONED--TECHNOLOGY, THE BASIC RESOURCES, AND CAPITAL AVAILABILITY--WILL NOT BE LIMITING. I WOULD ADD PARENTHETICALLY, HOWEVER, THAT IN THE CASE OF THE LATTER TWO, GOVERNMENT POLICY COULD ACT AS A LIMITATION.

YOU AND OTHERS HAVE EXPRESSED KEEN INTEREST IN FOUR OTHER PARAMETERS INVOLVING OIL SHALE--BUT WHICH HAVE COUNTERPARTS FOR WESTERN COAL-BASED SYNFUELS AS WELL. THESE ARE WATER, INFRASTRUCTURE AND SOCIAL IMPACT, ENVIRONMENTAL ISSUES AND LEASING POLICY. THEY PRESENT MORE DIFFICULT QUESTIONS, AND I WANT TO SHARE WITH YOU SOME OF OUR THOUGHTS ON EACH.

o FIRST, THE NEED FOR WATER. SEVERAL STUDIES, INCLUDING OUR OWN, SUGGEST THAT WATER FROM LOCAL SOURCES WOULD PERMIT CONTINUOUS DEVELOPMENT OF A SHALE OIL INDUSTRY THROUGH THE LATE 1990'S UP TO A LEVEL OF 1.5-2.0 MMB/D. BEYOND THAT LEVEL, INTERBASIN WATER TRANSFERS WOULD BE REQUIRED. THESE APPEAR TO BE PHYSICALLY FEASIBLE. THE BASE LOAD COST OF INTERBASIN WATER TRANSFER WOULD PEPRESENT A VERY SMALL PERCENT OF THE COST OF SYNFUELS AND COULD BE BORNE BY THE SYNTHETICS INDUSTRY. THIS WOULD, IN FACT, MAKE IT POSSIBLE TO SIZE THE FACILITIES TO BRING IN INCREMENTAL WATER FOR AGRICULTURAL, UTILITY, MUNICIPAL, AND OTHER USES ON ATTRACTIVE TERMS.

WE RECOGNIZE THAT FEW SUBJECTS ARE OF GREATER CONCERN IN THE WEST THAN WATER. INTERBASIN TRANSFERS ARE NOT NEW. THEY WERE PIONEERED IN THIS COUNTRY IN COLORADO. BUT THEY HAVE ALWAYS COME ONLY AFTER LONG DEBATE AND EFFORT. TO DEVELOP SUCH INTERBASIN TRANSFERS FOR SYNTHETIC FUELS WILL REQUIRE THE INVOLVEMENT AND ACTIVE PARTICIPATION OF ALL THE AFFECTED STATES AS WELL AS THE FEDERAL GOVERNMENT.

THE TIMING FOR SUCH TRANSFERS IS THE LATE 90'S, WHICH MAKES THIS SEEM DOABLE, IF WE START NOW. THE PRESENT CHALLENGE IS TO CREATE ACTION GROUPS TO DEVELOP PLANS, NOT FURTHER STUDIES TO DEFINE CONSTRAINTS.

O LET'S TURN NOW TO THE SECOND PARAMETER, INFRASTRUCTURE AND SOCIAL IMPACT. AS INDICATED IN OUR JULY 17 TESTIMONY, WE SUPPORT THE IMPACT ASSISTANCE LEGISLATION RECENTLY APPROVED BY THE SENATE AND STAND READY TO WORK WITH YOU AND OTHERS TO OBTAIN NEEDED COMMUNITY IMPACT ASSISTANCE LEGISLATION. WE HAVE COMMENCED EFFORTS TO GET SEVERAL ORGANIZATIONS TO CONSIDER--OR RECONSIDER--THEIR POSITION ON SUCH LEGISLATION. I MUST HASTEN TO ADD, HOWEVER, THAT A LARGE PART OF THE FUNDS FOR INFRASTRUCTURE DEVELOPMENT WILL COME THROUGH EXISTING CHANNELS FROM BOTH PUBLIC AND PRIVATE SOURCES.

I BELIEVE MANY COMPANIES INVOLVED IN SYNFUELS ARE SENSITIVE TO AND RECOGNIZE A REPONSIBILITY TO HELP MITIGATE THESE SOCIO-ECONOMIC IMPACTS. CERTAINLY, EXXON DOES. PLANNING FOR THESE IMPACTS AND THE CREATION OF THE REQUIRED INFRASTRUCTURE MUST INVOLVE MANY CONSTITUENCIES: THE PRODUCING COMPANIES, PEOPLE AT THE LOCAL LEVEL DIRECTLY AFFECTED, EXISTING BUSINESS AND CIVIC GROUPS, GOVERNMENTS AT LOCAL AND STATE LEVELS, ACADEMIC AND OTHER INSTITUTIONS.

EXXON LOOKS FORWARD TO PARTICIPATING IN SUCH AN EFFORT. IT MAY BE NECESSARY TO CREATE SOME NEW ENTITIES TO COALESCE THESE INTEREST GROUPS INTO A RESULTS-ORIENTED EFFORT IF WE ARE TO EFFECTIVELY DEAL WITH THE MANY ASPECTS OF THE PROBLEM.

ALONG THESE SAME LINES, YOU HAVE ASKED WHETHER EXXON WOULD BE WILLING TO ASSIST IN THE FINANCING OF HOMES FOR PEOPLE WORKING IN THE OIL SHALE INDUSTRY. AS YOU KNOW, AN IMPORTANT ELEMENT OF THE COLONY PROJECT IS THE BATTLEMENT MESA COMMUNITY. IT WILL BE DEVELOPED BY PRIVATE FUNDS ACCORDING TO A MASTER PLAN APPROVED BY GARFIELD COUNTY AND OTHER APPROPRIATE AGENCIES. BATTLEMENT MESA WILL BE AN "OPEN COMMUNITY," AS OPPOSED TO A "COMPANY TOWN," AND ULTIMATELY INVOLVE MORE THAN 3,000 ACRES AND SOME 7,100 DWELLINGS. IT WILL INCLUDE SITES FOR CHURCHES, SCHOOLS, A MAJOR OPEN-SPACE SYSTEM, RECREATIONAL FACILITIES AND COMMERCIAL BUILDINGS. THE PLANS CALL FOR A RELATIVELY BROAD RANGE OF RENTAL UNITS AND LIVING UNITS FOR PURCHASE. IT IS CONTEMPLATED THAT THE LIVING UNITS WILL BE SOLD AT PRICES PREVAILING IN THE GENERAL MARKETPLACE AT THE TIME. THERE ARE NO PRESENT PLANS FOR EXXON TO ASSIST IN THE FINANCING OF HOMES AS SUCH; WE ANTICIPATE HOMES IN BATTLEMENT MESA WILL ATTRACT NEEDED CAPITAL FROM THE NORMAL MONEY MARKETS.

- THIRD, THE ENVIRONMENTAL ISSUES. ALTHOUGH WE HAVE DONE SOME WORK, THE ENVIRONMENTAL QUESTIONS MUST BE ADDRESSED IN FURTHER DETAIL. NEITHER WE NOR ANYONE ELSE, TO OUR KNOWLEDGE, HAS DONE THE FULLY DETAILED STUDIES NEEDED TO ASSESS THE IMPACTS OF A LARGE SCALE INDUSTRY. BASELINE STUDIES AND ENVIRONMENTAL IMPACT WORK FOR SUCH AN INDUSTRY MUST BEGIN NOW.

YOU HAVE ASKED SPECIFICALLY WHETHER WE "---HAVE ANY INFORMATION THAT INDICATES AIR POLLUTION CONTROL TECHNOLOGY CAN BE IMPROVED ENOUGH TO AVOID MAJOR VIOLATIONS OF PUBLIC HEALTH STANDARDS" AND WHETHER WE "---AGREE OR DISAGREE WITH THE PRELIMINARY EPA ESTIMATES THAT EXISTING TECHNOLOGY WOULD VIOLATE HEALTH AND SAFETY STANDARDS." TAKING THE LAST QUESTION FIRST, POLLUTION CONTROL TECHNOLOGY TO BE EMPLOYED IN THE COLONY PROJECT, AND WE BELIEVE IN OTHER EARLY PLANTS, WILL MEET ALL EXISTING ENVIRONMENTAL REQUIREMENTS. FURTHERMORE, I WOULD STATE CATEGORICALLY THAT THE OIL SHALE INDUSTRY WILL ONLY DEVELOP IF IT DOES IN FACT MEET PRIMARY HEALTH AND SAFETY STANDARDS. THERE ARE NO DATA TO SUGGEST THAT THE EXISTING TECHNOLOGY DOES IN FACT VIOLATE PRIMARY HEALTH AND SAFETY STANDARDS.

TURNING NOW TO THE FIRST QUESTION, IF, IN FACT, A MULTI-MILLION BARREL OIL SHALE INDUSTRY IS TO DEVELOP, THE ENVIRONMENTAL EFFECTS CANNOT LOGICALLY BE ASSESSED BY EXTRAPOLATING MODELS CREATED TO STUDY THE FIRST ONE OR TWO PLANTS TO EVALUATE THE IMPACT OF A MATURE INDUSTRY DEVELOPED OVER THIRTY YEARS. AS HAS HAPPENED IN OTHER INDUSTRIES, ONE WOULD LOGICALLY EXPECT BOTH PROCESS TECHNOLOGY AND CONTROL TECHNOLOGY FOR OIL SHALE TO IMPROVE AS THIS INDUSTRY MATURES OVER THE NEXT 30 YEARS.

IN SUMMARY, WE BELIEVE A SIZEABLE INDUSTRY CAN BE DEVELOPED WHICH WOULD NOT VIOLATE FUNDAMENTAL HEALTH AND SAFETY STANDARDS AND WHICH WOULD MEET THE EXPECTATIONS OF REASONABLE PEOPLE.

0 FINALLY, A WORD ABOUT LEASING. THE FEDERAL LEASING PROGRAM FOR THE PICEANCE BASIN MUST BE GEARED TO WHATEVER LONG-TERM EXPECTATIONS THE NATION FINALLY SETS FOR AN OIL SHALE INDUSTRY. A PIECEMEAL APPROACH WILL NOT SUFFICE. THE DEPARTMENT OF THE INTERIOR HAS RECENTLY TAKEN THE INITIATIVE TO EXPAND THE PROTOTYPE OIL SHALE LEASING PROGRAM AND TO STRUCTURE A PERMANENT LEASING SYSTEM.

FOR THE OIL SHALE INDUSTRY TO DEVELOP CONSISTENT WITH THE SCENARIO I HAVE PRESENTED, THE PERMANENT LEASING SYSTEM MUST BE PUT IN PLACE WITHIN THE NEXT TWO OR THREE YEARS AND MUST INCLUDE LEASE TERMS WHICH ACCOMMODATE LARGE-SCALE SURFACE MINING IN APPROPRIATE AREAS OF THE BASIN. WE SUPPORT INTERIOR'S INITIATIVE TO REMOVE THE MAXIMUM FEDERAL LEASE HOLDING LIMITATION OF 5,120 ACRES BY ONE COMPANY, AND TO ALLOW OFF-LEASE DISPOSAL OF SPENT SHALE AND OFF-LEASE SITING OF PROCESSING FACILITIES.

IN CONCLUSION, THE U.S. CLEARLY HAS THE POTENTIAL FOR A MAJOR SYNFUELS INDUSTRY. THE COUNTRY'S POTENTIAL CAN BE ACHIEVED, WE BELIEVE, IN WAYS THAT ARE SOCIALLY, ENVIRONMENTALLY, AND POLITICALLY ACCEPTABLE. REALIZING THE TIMELY DEVELOPMENT OF OUR FULL SYNFUELS POTENTIAL WILL REQUIRE THE COORDINATED EFFORT OF THE PRIVATE SECTOR AND GOVERNMENT AT THE LOCAL, STATE, AND NATIONAL LEVELS. IT IS NOT AN OVERSTATEMENT TO SAY THAT IT WILL, IN FACT, REQUIRE A COMMITMENT OF A MAGNITUDE NEVER ACHIEVED IN PEACETIME IN THE HISTORY OF OUR COUNTRY. FORTUNATELY, IF WE GET ON WITH IT, THERE IS STILL TIME.

THE FIRST STEP IN THE PROCESS IS TO EXPAND THE PUBLIC DISCUSSION INVOLVING THOSE WHO WILL BE DIRECTLY AFFECTED--BE THEY CITIZENS IN THE AREAS OF POTENTIAL SYNFUELS PRODUCTION OR THAT BROADER GROUP OF CITIZENS WHO ARE AFFECTED BY THE IMPACT OF THE DRAIN ON OUR ECONOMY OF EXCESSIVE FOREIGN OIL IMPORTS OR WOULD BE AFFECTED SHOULD THOSE FOREIGN IMPORTS BE CUT OFF.

THE HEARING TODAY, THE ONE IN DENVER LAST MONTH, AND OUR MEETING IN GRAND JUNCTION THIS WEEK ARE ALL A PART OF THAT PROCESS.

THANK YOU AGAIN FOR THE OPPORTUNITY TO BE PART OF THESE PROCEEDINGS.

I WOULD NOW BE HAPPY TO ANSWER ANY QUESTIONS YOU OR OTHERS ON THE PANEL MIGHT HAVE.

Senator HART. We now will hear from a panel of witnesses having to do with the issue of water supply. Mr. Monte Pascoe, director of Colorado Department of Natural Resources; Mr. Roland Fisher representing Club 20; and Dr. Peter House, U.S. Department of Energy.

Gentlemen, thank you very much for being here. As is almost inevitable under these circumstances, we're now falling way behind. Consequently, I'll urge you as much as possible to summarize your remarks. As usual, the full text of prepared statements will appear in the record. And what we really want to do as much as possible today is get into an exchange of ideas of questions and answers.

So we'll start with Mr. Pascoe representing the State Department of Resources. I'll urge you for the people in the back of the room to speak as loudly as possible directly into the microphone.

STATEMENT OF D. MONTE PASCOE, EXECUTIVE DIRECTOR, COLORADO DEPARTMENT OF NATURAL RESOURCES

Mr. PASCOE. I have made a presentation more than a month ago to this committee. I sent that presentation I think to most of the members of the panel, and I'll try to get it to most of the other members of the panel. I do not intend to repeat that statement except to underscore the important role the Federal Government must play and is playing as the financier of the oil shale industry. I emphasize that a month ago, and I do want to emphasize it again.

The Federal Government has a commitment to see an industry in place that will make a significant contribution to our sources of liquids for energy. This commitment goes well beyond prior assistance to an industry, as was explained at a recent news conference held by the Assistant Secretary of the Department of Energy for Resource Applications. The Assistant Secretary said, quite frankly so far as she was aware, this is the first time the Government had tried to put an industry in place. It seems to me that changes the perspective of what the local governments and State government have to deal with.

The State is hopeful the Federal Government's commitment will include attention to and assistance for the full range of impacts—social, economic, and environmental—that this unusual, unprecedented effort by the Federal Government to put an industry in place will bring.

Colorado understands the need for oil from shale. Our numbers may differ from time to time about the proper size of the industry and about how much oil from shale in Colorado may be reasonable and wisely expected. However, we have and will continue to cooperate with the Federal Government and the industry in the effort to obtain oil from shale and in the effort to thoughtfully establish reasonable and financially, socially, and environmentally sound production goals for the oil shale industry.

WATER AVAILABILITY FOR OIL SHALE DEVELOPMENT

One month ago, we had apparent differences with other witnesses about available water for the development of oil shale. You have requested me to address this concern and to address the feasibility of interbasin transfers of water.

I said last month that from 5 to 700,000 barrels a day could be produced in Colorado without seriously impairing water for agriculture, recreation, and other existing industries. This was computed by taking virgin flows, making allocations for a variety of compact commitments, and by reducing the amount available to Colorado by the amount consumed today and by reasonable but not worst case assumptions about how much water, now decreed, will be used in the future for agriculture, power facilities, municipal, and industrial needs, other than related to oil shale, and transmountain diversions. We then took the remaining amount and calculated the production that could be achieved.

This analysis is consistent with the 13(a) assessment prepared for the Water Resources Council by the Department of Natural Resources. That assessment assumed, in the baseline case, 625,000 barrels of production a day in the White River Basin and 200,000 barrels in the Colorado River Basin. The report added that these assumptions may not be appropriate for Colorado and New Mexico because of compact restraints. The numbers I have used—500,000 to 700,000 barrels per day—reflect an effort to further refine the material in the 13(a) assessment. The computation we have made reflects our best judgment in prudently planning for available water supplies. An exercise, I might add, that we frequently have to do in this part of the country.

SALE OF EXISTING AGRICULTURAL RIGHTS

It should be noted that existing agricultural rights have already been purchased by several companies. We know of several such purchases but not all as they are private transactions. When and if these water rights are used for oil shale production, the lands they now irrigate will be dried up. These purchases of senior water rights add to the water available for oil shale. But they reduce the amount available for agriculture, an impact that we hope to avoid.

One will always argue with assumptions made. In fact, assumptions can be made that would show more water available and that would show none available. And I believe that Roland Fisher will speak to a couple of these issues that could even further impact our water supplies. I have reviewed the assumptions for our projections and find them to take into account and fairly consider the wide variety of water requirements of Colorado citizens in other river systems tributary to the Colorado River as well as the non-Colorado River Basin citizens of this State.

We expect site-specific studies will soon be requested. These studies should provide much more precise information about available water. And as I mentioned in my testimony last time, it's only this type of study that really gives you the detail and the precision that is necessary.

Senator HART. Excuse me. When do you expect that to be available?

Mr. PASCOE. My understanding is the preliminary requests have been made and that arrangements are now being made for the more site-specific studies to be actually prepared. We are just beginning the process, so——

Senator HART. Might that be a year or 6 months?

FEASIBILITY OF INTERBASIN TRANSFERS

Mr. PASCOE. I would hope in some instances they could be done faster than a year, and I think they should be done faster than a year.

We were also asked about interbasin transfers. Our experience in the West and in Colorado is that interbasin transfers of water are vigorously opposed, very difficult to achieve, and require many, many years to accomplish. One need only look at the effort to divert Columbia River water to the Colorado River. If the water were to come from the Mississippi River system, the number of States affected by such a transfer can be easily computed. I have very substantial doubts, even considering the great need for liquid energy resources, that such a transfer could be accomplished.

Thank you very much, Senator. I appreciate the opportunity to be here.

Senator HART. Thank you, Mr. Pascoe. I'm sure we'll have a number of questions.

One of the State's leading water authorities, Mr. Roland Fischer, for Club 20.

STATEMENT OF ROLAND C. FISCHER, SECRETARY-ENGINEER, COLORADO RIVER WATER CONSERVATION DISTICT

Mr. FISCHER. Senator, if I may I'd like to correct the record and the agenda. I am here for the Colorado River Water Conservation District. I'll give the reporter a card so that the record can correctly reflect that I am not here for Club 20 but I am instead here for western Colorado's primary water policy body.

I do not have a written statement. I talked to your staff a few days ago and have been out of town since. I would like to make a few remarks. I'd like to enlarge a little bit on what Monte Pascoe has said.

I think the panel and the industry probably understands that the Colorado River is probably one of the most controversial, most controlled, most political rivers in the world. As energy resources come on line, that controversy is not going to decrease but instead the river is going to become significantly more controversial.

COLORADO RIVER BASIN STORAGE FACILITIES

The supplying of water for the associated municipal uses as well as the direct oil shale processing is going to require new storage facilities in the Colorado River basin. The Colorado River District is the primary western Colorado water policy body and our policy is that as the industry uses come on line, the industry should supply and pay for its own storage. This policy has been in part either ill-explained, the blame for which I will take, or not well understood by the industry. The river district has a policy of wanting to provide irrigation agriculture with the opportunity at least to continue to function as a viable part of the economy. And we believe that water should be available for irrigation use; that is. Certainly a water right is a property right. Anyone can buy a water right and separate it from the land, and that opportunity should be left to the owner of that water right, further recognizing that water in the State of Colorado is the property of the public, and the right to divert it to beneficial use shall never be denied.

I think what a lot of my friends in the industry don't really understand is that in the acquisition of irrigation water, that water can be used for another purpose to the extent of the consumptive use portion only, in the irrigation season only, and therefore there is not probably so much water available as some uninitiates may think. Even so, to utilize that water storage would probably be required.

Incidentally, in a stipulation involving this very issue, the river district and the Union Oil Co. of California stipulated to those provisions, but further that the land is to be left on the tax rolls as irrigated land.

ADEQUATE WATER AVAILABLE FOR INDUSTRIAL AND MUNICIPAL USE

We believe that there is water available from existing reservoirs certainly on an interim basis for an oil shale industry and the associated municipal uses. I am, of course, thinking of Ruedi Reservoir and Green Mountain Reservoir. The use of water from Ruedi Reservoir for municipally associated and direct industrial purposes is going to be controversial. There's no question about it.

The river district's position is that water can be made available to some extent from Green Mountain, though very limited; and to a greater extent from Ruedi Reservoir. The river district's position is that Ruedi Reservoir water is probably the lowest-cost water in place on the Western Slope today. We believe that it should be made available to an industry in reasonable amounts but that there are municipalities like Rifle, DeBeque, Parachute formerly Grand Valley—why they did that I'll never know—Grand Junction. And it is those municipal users who should benefit by that relatively low cost water instead of impacting the tax rolls with general obligation bond to build storage say in 1990 for an increased population associated with an energy industry and thereby burden the taxpayers. It is instead the river district's policy that those taxpayers should get the benefit of the lowest cost water. And here's where the river district falls apart from both our friends in the environmental community and our friends in industry. But I can assure you that I've been alone before.

INDUSTRY SHOULD SUPPLY AND PAY FOR OWN WATER STORAGE

The industry we believe should supply and pay for its own storage and should pay for water from existing facilities at a price calculated to be the least cost alternative price from a single-purpose reservoir, the cost of that facility to be agreed upon between the industry and the river district, Azure, Edwards, "Bear Wallow," "Una." And, thereby, the industry would supply and pay for its own water.

It is interesting that some in the industry are talking, and specifically Exxon, about importation from the Missouri River basin, a politically sensitive issue. As a member of the Office of Technology Assessment Oil Shale Committee, I participated in a report recently completed—and, of course, I commend it to careful study—imported water is the highest priced water to the extent of approximately $1 a barrel of water per barrel of crude shale oil. The cost from other sources we think is about 50 cents.

Now, understand that the river district's policy is that water is the property of the public. And at the end of the life of the industry, we believe that a public agency should control the water resources facilities. When industry is finished, this country will still be growing white-faced cows. We think that the water and—sheep.

Senator **Hart**. White-faced sheep——

Mr. Fischer. Well, it's an election year. The public should control that water. And we think one of the best ways is, of course, through a public agency whether it's the State, the river district, or a concerned conservancy district should have the title to those facilities.

Now, I think it's obvious on the face of it what we think is the best thing to do to finance the reservoirs is to bank the industry's balance sheets. There's no question about that. And to supply water to the industry on a reasonable cost basis and to then at the end of that time, Senator, have that water available for irrigated agriculture, white-faced cows, or white-faced sheep.

FEDERAL REGULATIONS MAY IMPEDE OIL SHALE DEVELOPMENT

I would like to make a couple of comments that I think are probably relevant here today. I've heard the industry talk about regulations and the problems associated therewith. I think that one of the most obvious ones that we can see is the prohibition, indeed, a moratorium on even a study, to export water from the Columbia River Basin to southern California and then move that Colorado River water back upstream on paper. It's a very political issue.

I understand that Senator Frank Church has a bill pending in committee—nothing has happened to it—to prohibit any kind of import of water into the Colorado River Basin, not just from the Columbia. I've been in touch with your staff on this matter. I think that these issues are going to have to be resolved in a political arena. And certainly, Northwest United States has contributed mightily to the energy resources of this Nation through hydroelectric.

But the jealousies that we have, the regionalism—and I think a statement was made by an outstanding U.S. Senator that energy can Balkanize this country. We don't want to see that happen. But the question about moving water on paper upstream in the Colorado River Basin as a result of meeting lower basin supplies should be given a careful look.

I would submit for your careful consideration that one of the greatest impediments to the development of oil shale in the Western United States is going to be the Endangered Species Act of 1976. The Colorado River Water Conservation District has pending on license application before the Federal Energy Regulatory Commission an application for 148 megawatts of hydroelectric power which is the equivalent of 600,000 barrels of oil a year. Our only serious opposition is the United States itself.

We have problems, as has been fairly well publicized, with the Colorado River squaw fish. We have problems, of course, with wilderness areas, the Federal Land Policy Management Act, and the interpretation about whether or not a site withdrawn for hydroelectric purposes in 1919 should now be built or whether the Department of Interior—who, by the way, are probably the Western United States' most significant adversary; and this is what the sagebrush rebellion is all about—whether the Department of Interior has the power today to change the laws of the U.S. Congress.

I would say that western Colorado stands ready to help meet these energy-related, water-related resources problems. And one of the best examples is that on August 19, 1980, the western portion of Rio Blanco County, specifically the town of Rangely, voted over 10 to 1 to bond themselves to go into debt for $13 million to put a reservoir on the White River. I think the most significant thing that has happened in western Colorado water resources in a long, long time, and I think it speaks volumes.

Thank you very much, Senator.

Senator HART. Thank you.

Dr. House?

STATEMENT OF PETER HOUSE, DIRECTOR, OFFICE OF ENVIRONMENTAL ASSESSMENTS, DEPARTMENT OF ENERGY

Dr. HOUSE. Since Mr. Pascoe and Mr. Fisher covered a lot of the details I intended to cover in testimony, I'll skip through some parts of this.

I'd like to take the opportunity to thank you for entertaining the Department of Energy's testimony. I'll focus today on some of the questions you asked of me in Denver at the earlier hearing; namely, why are there so many differences in the estimates of oil shale production possibilities using such factors as air quality, water availability, socioeconomic constraints. My testimony addresses all three of these. I'll focus on the water availability right now.

The first thing that might be of most interest is that the question of how much water there is has never really been discussed. Most of the earlier studies and most of the studies I'll refer to you today ask questions like: If you've got an industry at a level of 400,000-, 500,000-barrels-per-day capacity, is there enough water to service that industry? We have not been able to find a study that specifically addressed the question of how much carrying capacity you could have.

WATER REQUIREMENTS OF OIL SHALE INDUSTRY

Let me go on to some of the specifics. I'll talk to the water requirements for the oil shale industry, of the water supply itself, and then switch the focus from flow to the ground water per se. Another general lesson that we picked up as we went through a large number of these studies is they're so incredibly dependent on the assumptions made by the technicians actually doing the study.

Let me spend just a second on the water requirements for oil shale itself. A recent study done by the General Accounting Office in January 1980, entitled "Water Supply Should Not be an Obstacle to Meeting Energy Development Goals," addressed the issue of varying estimates of the water requirements of the oil shale industry itself. It referred to earlier studies done by the Federal Government also, in fact to the Department of the Interior's 1974 report entitled "Water for

Energy in the Upper Colorado River Basin." And we felt that these earlier studies were much too conservative.

It said, for example, that the growth rate estimates of power demand in the West decreased by over 30 percent from 1974 to 1977. Also, the same powerplants would be expected to consume much less water than the earlier study estimates. The present study estimated 8,000 to 13,000 acre feet per 1,000 megawatts rather than for earlier estimates of 15,000 to 20,000 acre feet per 1,000 megawatts.

Over time, similar water-conserving or water-efficient methods have been applied to projected synthetic fuel technologies also, lowering projected water requirements from earlier levels. These same 1974 studies estimated water requirements per 100,000-barrel-per-day oil shale operation at over 17,000 acre feet per year while the recent Colorado DNR studies in 1979 estimated it to be about 11,500 acre feet per year for the same 100,000 barrels per day production, a reduction of about one-third.

However, even here if you look at the water requirements for specific projects, they range from 4,900 acre feet a year to over 10,000 acre feet per year for a 50,000-barrel-per-day plant. If you take averages of this or either one of those ranges, you can end up with significant differences in the amount of water required for the industry.

WATER SUPPLY

Let me skip over to water supply. In the water supply area, again going back to the study by the Colorado Department of Natural Resources that we discussed earlier, I want to go further and repeat some of my earlier testimony. Late this fall the Water Resources Council will publish a condensation of the draft Colorado Department of Natural Resources report along with the assessment of the lower basin effects on energy development in the upper basin. Colorado's draft report addressed a hypothetical base line scenario for the year 2000 of 1.3 million barrels per day of oil share 825,000 of which was sited in Colorado. Let me stop there and underline what I said when I opened my testimony: This is typical of most of the studies done; in other words, there is an assumption made as to the size of the industry and then the question of whether there's adequate resources looked at, not the other way around. This study concluded that the water demands of such an industry and its associated growth could be satisfied from surface water without having an impact on other projected consumptive uses in the upper basin.

What I did not talk about earlier was that as part of this draft report, the study also looked into what is called an accelerated level of oil shale development, that is of 2,400,000 barrels a day, 1,700,000 of which was in Colorado. The Denver Department of Natural Resources report indicated that even this level of development might be accommodated with greater storage development and associated costs.

GROUND WATER

Let me skip over the water rights and interbasin transfers since they were covered earlier and bring you to one other section of the water availability question which I touched upon in the question and answer period last time but not in the testimony. All of the studies we have found so far lean heavily on surface flow as the main source of water available for the oil shale industry. Not much work has been done in the area of ground water, and we also have not done much work in general in the area of impacts of ground water level on flow rates. But let me give you some figures.

Most water availability assessments, including the oil shale assessment by the Colorado DNR, have limited the available water supply options to surface water, as I just said. The Colorado DNR assessment pointed out that the estimates of ground water in storage in the Piceance basin range from 2.5 to 25 million acre-feet. The amount of water which is discharged to surface streams and recharged primarily by snow melt is estimated at from 26,000 to 29,000 acre-feet per year.

If only an amount equal to the recharge rate in the Piceance basin were developed, it could support as much as 250,000 barrels per day of oil shale development.

The recent Office of Technology Assessment report that was referred to entitled "An Assessment of Oil Shale Technologies" indicated that much of the stored water in the Piceance basin is of such low quality that its use for nonenergy purposes would not likely increase. It further estimated that if oil shale developers upgraded this ground water and utilized 15 percent of the maximum 25 million acre-feet, these aquifers alone could supply a million-barrel-per-day industry for 20 years. I thank you, Senator Hart.

Senator HART. Thank you, Dr. House.

PREPARED STATEMENT OF PETER HOUSE, DIRECTOR, OFFICE OF ENVIRONMENTAL ASSESSMENTS, DEPARTMENT OF ENERGY

Mr. Chairman, I would like to take this opportunity to thank you for entertaining the Department of Energy's testimony on this critical subject. The Department is very concerned with the environmental impacts which the oil shale industry will have upon the residents of Colorado as well as elsewhere. As demonstrated in our testimony, we are especially concerned about the air quality, water availability and negative socioeconomic impacts. We will discuss specific historical trends in the analyses in these areas in our testimony.

For the air quality and water availability areas, we now have better estimates concerning carrying since the availability of our data and quality of analytical methods have improved over time. In addition, in the recent past, there has been an upward revision in the oil shale production carrying capacity level which the Piceance Basin could support.

In the socioeconomic area, we see a similar trend, i.e., a variation in conclusions within an impact range. This range, we believe, will likely narrow as we learn more about the production technologies and geographic area over time. Our current socioeconomic impact assessment methods and data are not as reliable or as exact as those of the first two areas. More work in the socioeconomic area is obviously required.

OIL SHALE: AIR

A number of studies conducted since 1976 have examined the air quality impact of oil shale. At first glance several of these reports appear to be enormously contradictory; some say there can be essentially no oil shale development while others predict a substantial industry can be built. However, a closer examination of these reports suggests other conclusions. Early estimates, based on whatever information was available, tend to be conservative. As the body of information on oil shale has grown over time, these conservative assumptions have moderated, yielding generally higher projections for the size of an industry which can be sited. Another important factor is that, generally, the focus of these reports has been to identify the impact of a single plant or an assumed level of development (e.g., 200,000 barrels per day), rather than to determine the maximum level of development possible due to air quality regulatory constraints. This means there is likely to be a range of estimates, none of which, however, is aimed at the maximum carrying capacity of a region. A brief review of these studies is informative.

A 1976 report for the Energy Research and Development Administration gave perhaps the lowest estimate for oil shale development when it stated: "control levels beyond the best available technology will be needed for particulate and SO2 emissions from synthetic liquid fuel plants."1/ Using the TOSCO II process as a prototype, the study noted a single 100,000 barrel per day plant could not be sited without a significant reduction in particulate emissions, and a marginal reduction in SO2 emissions.

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1. Synthetic Liquid Fuels Development: Assessment of Critical Factors, ERDA 76-129/2, 1976, Vol. II, p. 579.

DOE published studies in July 1979 and June 1980 on synthetic fuels. The 1979 study concluded that "air quality considerations would not preclude construction of judiciously sited and efficiently controlled" oil shale technologies, up to the 400,000 barrel per day Administration proposal.[2] The 1980 study also concluded that the 400,000 barrel per day level was practical from an air quality perspective.[3] No upper limit was determined.

Several EPA papers have also examined the air quality impacts of oil shale development. A 1976 memorandum from David Joseph to Terry Thoem (both in EPA's Denver Office), stated a 200,000 barrel per day capacity was feasible. A November 1979 analysis based on the Colony and Union oil permit applications also identified 200,000 barrels per day as acceptable. In a paper presented this past spring in Golden, Colorado, Mr. Thoem raised the estimate to 400,000 barrels per day, based on a "box" model (most of the other studies cited here are based on diffusion models). These limits were projected as due to PSD I areas and SO2. A draft study prepared by EPA (IERL), which we understand will be circulated for comment shortly, concludes that at least a 850,000 barrel per day capacity can be sited. Finally, in his July 17, 1980 testimony before Senator Hart, Mr. Thoem projected air quality constraints starting at the 1.1 million barrel per day level (due to ozone).

Based on the earlier EPA analysis (spring, 1980), the Office of Technology Assessment stated that the Clean Air Act "could limit production in Colorado to 400,000 barrels per day."[4]

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2. Environmental Analysis of Synthetic Liquid Fuels, DOE/EV, 7/79, p. 62.

3. Synthetic Fuels and the Environment: An Environmental and Regulatory Impacts Analysis, DOE/EV, 6/80, Chapter V.

4. An Assessment of Oil Shale Technologies, Office of Technology Assessment, U.S. Congress, 6/80, pp. 4, 256.

A summary of the outcome trend of these reports is presented in Figure 1.

One should be careful not to read too much into the apparent trend these projections present. They indeed can be seen to represent a shifting opinion as to how much capacity can be safely sited, but curve extrapolation is not justified, as explained below.

Several factors probably contribute to the increase in siting capacity projections. First, and probably most important, is the fact that in 1976, when these projections started, oil prices were too low to allow synthetic fuels to compete successfully in the marketplace. Therefore, interest centered on the feasibility of one or two demonstration plants, not an entire industry. Projections at that time, and to a lesser extent at later times, reflected their author's opinion that at least (not at most) a certain capacity could be sited. Secondly, technology has evolved in two directions. Both controls for specific shale technologies have improved, and inherently cleaner, second generation shale oil technologies have entered the projections. However, these improving technologies may not continue to evolve at the same rate. A third area of change, which is likely to continue changing with time, is modeling practices. The oil shale areas are typically irregular terrain, the most difficult modeling situation. They have been modeled differently in several studies. Development of better models will likely occur over the next few years, and this will affect the capacity deemed acceptable.

A final category of factors which have varied over time could perhaps best be termed "details." After the major decisions are made concerning what process will be modeled, what control technology will be assumed, and what model will be employed, a number of less conspicuous assumptions must be made. These include the source of power for the facility, the "cleanliness" of fuels burned on-site, the height of emission stacks, the ducting arrangements (minor air emission streams can be combined and emitted through a single stack), the plant configuration, and terrain assumptions.

Given all of these variables, it is remarkable, I believe, that the recent projections from different government organizations have been as close as they appear. Although air quality modeling is as much art as science, and is inherently inaccurate, it is the best tool we have to predict future impacts of plants and prevent degradation of our air resources.

In summary, over the past four years, various studies have predicted that sitable oil shale capacity using best available air pollution control technology could range between less than 100,000 barrels per day to over 1 million barrels per day. The trend, with respect to time, is towards a larger projected capacity. The two primary factors in these changes are:

- Technology controls are more detailed.
- Modeling techniques and assumptions have changed.

Figure 1: Summary of Air Quality Estimates

1976 (ERDA)

- o Based on TOSCO II
- o PSD Class II limits for PM
- o Controls beyond BACT needed to allow a single 100,000 BPD facility

September 1979 (EPA)

- o Based on extrapolation of first permits
- o Flattops PSD I SO2 is limiting factor
- o 200,000 BPD

Spring 1980 (EPA)

- o Based on EPA short-range models and announced plans
- o Flattops PSD I SO2 is limiting factor
- o At least 400,000 BPD

June 1980 Preliminary Study Results (EPA)*

- o Based on reactive plume models and extended plans
- o At least 890,000 BPD

July 17, 1980 EPA Testimony

- o Extrapolated from June data and announced plans
- o Ozone is first size limitor for health NAAQS
- o Colorado development limits due to NAAQS are:

--Ozone/0.9 million BPD
-NOx/3.1 million BPD

due to PSD I are:

--SO2/1.7 million BPD
--TSP/5.4 million BPD

* As reported in June 27, 1980, "Synfuels" newsletter; confirmed by July 14, 1980, telephone call from D. Carter (DOE) to T. Thoem (EPA).

WATER AVAILABILITY

The issue of water availability for oil shale development in Colorado is a complex one because it is a function of so many different parameters. To compound the issue even further, as important as the purely physical aspects of water availability are constraints imposed by the institutions governing the allocation, storage, and distribution of water resources.

In the long term, availability is a function of average annual surface flow and groundwater that can be recharged, less that amount of water which is currently being utilized, demands set by lower Basin rights, and all projected future energy and non-energy demands in the Upper Colorado basins. Long-term availability is not the only consideration necessary for a determination of water availability, since oil shale facilities require a continuing water supply during low flow as well as high flow conditions.

For this reason, short-term or instantaneous supply is a function of unallocated surface flow, drawdown from impoundments and reservoirs and groundwater, less existing demands (including protection of instream flows for environmental purposes), lower basin rights, and a factor to allow for constraints--based on restrictions to inter-basin transfer and on priority of uses--on redistribution of water from impoundments.

I would now like to address each of these individual features which, taken together, will ultimately determine the net availability of water for oil shale development in Colorado. In doing this, I have drawn from studies by the Colorado Department of Natural Resources, Office of

Technology Assessment, the General Accounting Office, and the Department of Energy. Other studies exist, although these are the most recent. The most current and complete studies are those of the Colorado Department of Natural Resources. Among these Colorado studies is a draft regional assessment of the impact of emerging energy technologies--including oil shale development--on the region's water resources, done in cooperation with the Water Resources Council under the authority of Section 13(a) of the Federal Non-Nuclear Energy Research and Development Act of 1974.

Water Requirements for Oil Shale

The first key factor I will discuss is water requirement for various oil shale technologies. I believe that there still exists in some quarters a common misconception that there is not enough water to support energy development in the Upper Colorado basin. One of the probable reasons for this is that some early assessments predicted that water supplies simply were not adequate to meet projected energy requirements. A recent General Accounting Office (GAO) report in January 1980, "Water Supply Should Not Be an Obstacle to Meeting Energy Development Goals," addressed this issue and concluded that the Upper Colorado Basin should have sufficient water for energy development until at least the year 2000. In particular, it showed that many of the assumptions used in an earlier study, the Department of Interior's 1974 report, "Water for Energy in the Upper Colorado River Basin," have, in retrospect, turned out to be too conservative. For example, growth rate estimates of electric power capacity in the West decreased by over 30 percent from 1974 to 1977. In addition, power plants in the Upper Colorado basin actually consume much less water than that study estimated (8,000 to 13,000 acre-feet per 1,000 Mw, rather than estimated 15,000 to 20,000 acre-feet per 1,000 Mw).

Over time, similar water-conserving or water-efficient methods have been applied to projected synthetic fuel technologies, lowering projected water requirements from earlier levels. These changes are even larger on a unit basis as the engineering specifications of these new technologies are developed. The 1974 Interior study estimated water requirements for a 100,000 barrel per day oil shale operation at 17,400 acre-feet per year, while the Colorado DNR, in 1979, estimated an 11,600 acre-feet per year average per 100,000 barrels per day production--a reduction of over 33 percent per plant. In general, estimated water requirements for specific projects have ranged from 4,900 acre-feet per year to over 10,000 acre-feet per year for a 50,000 barrel per day plant, depending on the specific oil shale technology. These include projections made in a study by the Denver Research Institute sponsored by my office and completed in 1979, titled "Predicted Costs of Environmental Controls for a Commercial Oil Shale Industry." This report is often cited in other comprehensive assessments such as the Office of Technology Assessment report of June 1980.

The range of water requirements for four different oil shale technologies in that study are:

Paraho Direct	5,346 acre feet/year
Tosco II	10,694 acre feet/year
Modified Insitu (MIS)	5,817 acre feet/year
MIS with Lurgi	5,656 acre feet/year

These reductions in estimated water requirements hold true for other synthetic fuel technologies, and are a result primarily of (1) projecting more extensive use of dry cooling--which uses air rather than water--and (2) increased recycling and reuse of waste and process waters.

Therefore, the water requirements corresponding to a 500,000 barrel per day oil shale industry, including associated municipal growth, could range from less than 50,000 acre-feet/year to upwards of 100,000 acre-feet per year. As a comparison, current depletion by irrigated agriculture in the state of Colorado is approximately 1,200,000 acre-feet per year, out of total state of Colorado depletions of 1,800,000 acre-feet per year from the Upper Colorado River.

Water Supply

One of the reasons that water availability for oil shale development is a concern to people in this region, and to the Department of Energy as well, is that the West is a relatively arid region. Although the Colorado River basin is large in area, its flow is relatively small, averaging 13.8 million acre-feet between 1930 and 1974, compared, for example, with the much greater flows of the Columbia and Mississippi Rivers of 180 million and 440 million acre-feet per year, respectively.

In addition, flows vary annually and seasonally, being quite high during the spring snowmelt and extremely low in dry months. These flow variations, which become most critical when the low flow cannot meet all needs, have necessitated the construction of reservoirs or impoundments, to mitigate or dampen seasonal fluctuations, and augment natural supplies during dry years. Chart 1 illustrates the effect impoundment has on seasonal flow variations, expecially with respect to raising the level of low flows with captured spring runoff.

A number of reservoirs have been built in the region by the Water and Power Resources Service (WPRS), formerly the U.S. Bureau of Reclamation. Table 1, from the GAO report, lists some of these reservoirs in energy resource areas which could supply future water allocations to oil shale and other energy developments with their industrial allocations. In addition, the recent report by the Colorado Department of Natural Resources, "Colorado Oil Shale: The Current Status" (1979), indicated that the Green Mountain Reservoir may have 90,000 acre-feet per year available for sale.

The Colorado Department of Natural Resources has recently completed a draft assessment of water-for-energy for the Water Resources Council. This draft study, funded by the Department of Energy pursuant to Section 13(a) of the Federal Non-Nuclear Research and Development Act, is titled "The Availability of Water for Oil Shale and Coal Gasification Development in the Upper Colorado River Basin." Late this fall, the Water Resources Council will publish a condensation of the draft Colorado Department of Natural Resources' report along with an assessment of the Lower Basin effects of energy development in the Upper Basin. Colorado's draft report addressed a hypothetical baseline scenario in the year 2000 of 1.3 million barrels per day of oil shale, 825,000 of which was sited in

TABLE 1

Selected Reclamation Reservoirs Located
in Energy and Mineral Development Areas

Reservoir	Basin	Long-Term Industrial Allocation (acre-feet/year)
Ruedi	Upper Colorado (Frying Pan R.)	47,700
Fontannele	Upper Colorado (Green R.)	228,000
Navajo	Upper Colorado (San Juan R.)	115,250
Powell	Upper Colorado (Colorado R.)	142,000
	4 Reservoir Total	525,000

Source: GAO, CED-80-30

Colorado, and eight coal gasification plants (or a total of 1.5 million barrels per day liquids-equivalent). It concluded that the water demands of such an industry and its associated growth could be satisfied from surface supplies without having to impact other projected consumptive uses in the Upper Basin.

However, this conclusion is based upon several assumptions: that water is purchased from new or existing reservoirs and/or that new pipeline and pumping facilities are built to transport the water, and that no reductions in water available for use in the Upper Basin are required to guarantee needed flows in the Lower Colorado Basin, or to meet Mexican treaty requirements. The study estimated the total capitalized cost of such facilities at $1 billion for a 1.5 million barrel per day industry, or 1 to 2 percent of the capitalized costs of the energy facilities proper. Most of this additional reservoir capacity would be located in the White River basin.

The study also addressed an accelerated level of oil shale development of 2,400,000 barrels per day, 1,700,000 of which was in Colorado. The body of the DNR report indicated that even this level of development might be accommodated with greater storage development and associated costs.

In addition, the DNR projected depletions by non-emerging energy technology uses to increase from the current 3.8 million acre-feet to nearly 5.4 million acre-feet in the year 2000. To allow for protection of present users in the Upper Basin, several assumptions were made by the DNR, including a 500 percent increase in consumption by steam-electric power; no transfers of water rights from irrigated agriculture to oil shale; and all oil shale developers' water rights are junior to all other rights. The DNR draft report also assumed the construction of all currently authorized irrigation projects by 2000, although each project will, of course, have to be evaluated on its merits prior to any Federal decision to begin construction.

Water Rights

As you know, water rights in Western states are, in general, based upon the prior appropriation doctrine, under which applications for the right to use water are filed with State engineers or water courts. In the Upper Colorado Basin, conditional water rights, many of which have not yet been put to use, far exceed the actual flow of the Colorado. However, unallocated surface water is available in some of the sub-regions, as indicated by the Colorado Department of Natural Resources (DNR) draft assessment.

Many potential oil shale developers have acquired relatively large holdings of water rights, either in the form of conditional decrees or purchased irrigation rights. The following table (Table 2), from material gathered for the 1979 Environmental Protection Agency study, "Energy from the West" by the University of Oklahoma, shows estimated existing conditional water rights held by oil shale developers.

Table 2

Existing Rights	Estimated Quantity (acre-feet/year)
Colony	171,000
Union Oil	85,000
SOHIO	72,000
TOSCO	39,000
MOBIL	36,000
Superior	17,000
TOTAL	420,000

Other options for obtaining water are purchase of surplus water from existing reservoirs and construction of new reservoirs; interbasin transfers, which may be constrained by institutional problems and legal restrictions; and the development of groundwater supplies.

Interbasin Transfers

Interbasin transfers, or diversions of water from one major basin to another, have often been mentioned or proposed as alternatives to increase local water supply. Indeed, diversions from the Columbia and Upper Missouri River Basins to the Upper Colorado have specifically been pointed out as potential suppliers of additional water to the oil shale area.

Although the financial and physical feasibility of interbasin transfer seem viable, a number of institutional factors present some rather formidable obstacles. First, there is a Congressionally mandated moratorium (first required by the Colorado River Basin Project Act in 1968) which extends to 1988 on any reconnaissance studies by the Department of Interior of any plan for the importation of water into the Colorado River Basin.

Independent of the moratorium, there are two river compacts which incorporate provisions which would make it difficult to export water into the Colorado system. Both the Snake and Yellowstone River Compacts do not allow out-of-basin transfers without approval of the signatory states. No such compact provisions exist on the Upper Missouri.

Intra-basin diversions, or transferring water from one sub-basin in the Upper Colorado system to another (e.g., the Green River basin to the White River basin) are at least institutionally feasible. Such a diversion would be subject to provisions of the Upper Colorado Compact, especially with respect to state shares of river flow, and to prevailing conditions regarding existing water rights.

Groundwater

It would be worthwhile to discuss the potential for industrial use of groundwater in more detail. Most water availability assessments, including the oil shale assessment by the Colorado DNR, have limited the available water supply options to surface water. This is because, in general, not as much is known about groundwater as surface flows, which can be easily measured. The Colorado DNR assessment pointed out that estimates of the amount of groundwater in storage in the Piceance basin range from 2.5 million to 25 million acre-feet. The amount of water which is discharged to surface streams, and recharged primarily by snowmelt, is estimated at from 26,000 to 29,000 acre-feet per year.

If only an amount equal to the recharge rate in the Piceance basin were developed, it could support as much as 250,000 barrels per day of oil shale development. In fact, mine drainage water in the central portion of the Piceance basin where the current Federal lease tracts are located could produce from 6,400 to 18,000 acre-feet per year for those two tracts alone.

The recent Office of Technology Assessment report, "An Assessment of Oil Shale Technologies," indicated that much of the stored water in the Piceance basin is of such low quality (being high in dissolved solids and fluorides) that its use for non-energy purposes would not likely increase. It further estimated that if oil shale developers upgraded this groundwater, and utilized 15 percent of the maximum 25 million acre-feet, the aquifers alone could supply a 1 million barrel per day industry for 20 years. This rate of consumption would, however, exceed the recharge rate, and result in reduced surface flows in some streams in the Piceance basin. The Colorado DNR assessment indicates that groundwater development would produce much less adverse impact on fish and recreation than relying on surface water use alone.

Summary

In summary, it appears that sufficient options exist for developing the water necessary to support an oil shale industry in Colorado. Uncertainties related to each of these options preclude the detailed identification of the size of an industry that can be supported by available water resources.

Socioeconomic Impacts of Oil Shale Production

A common theme is evident within all the discussions being held today; that we are vitally concerned with the identification and management of environmental impacts associated with oil shale production. Analytical efforts in two of these areas, air quality and water availability, are well along toward specific identification and resolution of the magnitude of the problem. The third, direct and indirect socioeconomic impact, is not as well-defined in terms of the scope of the problem or mitigation requirements. Air and water impacts have been assessed using detailed deployment patterns and engineering specifications, while the financial and management initiatives required to provide adequate social service support need more in-depth analysis of the impacts related to the existing and new in-migrating population.

Types of Socioeconomic Impact

There are two types of socioeconomic impact which need to be addressed. The first is socio-psychological in nature. Rapid growth of rural areas, especially when due to the introduction of high-technology industries, may alter the way in which residents view their community and its characteristics. Often, such growth results in changes in how residents interact with one another, decreases the levels of social control and quality of life and creates conflicts between new and longtime residents. Social problems such as divorce, crime, drug abuse and mental illness usually accompany such growth. These socio-psychological impacts are not simply associated with the construction phase of the new industry, but rather are problems associated with the transition to and maintenance of a growing urban area.

The second impact is a more direct result of rapid growth. It is the inability of local and state governments to design and fund an infrastructure mechanism which adequately supports the rapidly growing population. This problem is especially acute during the initial stages before adequate public revenues are generated by the operation of the new facilities. Let me provide you some data which demonstrates the magnitude of the problem. According to the oil shale technology study prepared by the Office of Technology Assessment, the population level for the Piceance Basin associated with a 500,000 per day oil shale industry in 1990 is 280,000; 107,000 or 60 percent beyond the normally expected growth for the area expected prior to the accelerated energy technology development.

Both of these socioeconomic problems have common elements. Both have a related economic demand placed upon the local public sector. In both cases, up-front capital facilities are required within the geographic area, an area which currently has a minimum infrastructure support capability because of its rural nature. The population and economic behavior about which we are talking is not the classic "boom-bust" situation which has so often occurred in rural areas where a single large plant was added to a small community. Rather, it is a situation where we can expect rapid, but continuing, urbanization, with the industry base oriented toward expanding and long-time use of the area resources. These socioeconomic impact problems are therefore cash flow problems b

associated with an initial low capital base availability to the local government. The ultimate concerns in the socioeconomic impacts area are what quantity and quality of infrastructure support should be provided to the growing population and on what schedule? What is the associated cost and how can this cost be met?

The Impact Assessment Method

The assessment method used to answer these questions requires estimates of variables related to population growth, employment and area characteristics. The principal variable for these assessments is the technology mix and social deployment for the oil shale demonstration and production facilities. These parameters allow the definition of the labor force required to construct and operate these facilities. Based upon the work force level, indirect employment can be estimated. Also associated with work force is an additional population sector which represents the families of these laborers. Once these parameters are estimated, usually through the use of appropriate multipliers, the level, timing and cost of the required infrastructure can be estimated. These infrastructure costs can be met through direct revenue, subsidization, taxation and/or bond sales. The relationship between these various elements is demonstrated in Chart 2.

The assessment method mentioned above is also influenced by the character of the geographic area within which the oil shale production industry is located. The size and make-up of the historic labor force will influence the level of indirect employment which will occur and that must be met by new in-migrating workers. The physical topography of the area will affect the residential patterns of the growing population of new worker families while the economic base of the area will also affect secondary employment generation and growth rate beyond initial unused capacity. Finally, the level of the existing infrastructure support and the level of excess capacity which may exist will influence decisions concerning expansion of the infrastructure system and its cost. For example, the Office of Technology Assessments study projects that the present and planned structure of the communities of the Piceance Basin can support an oil shale industry of approximately 133,000 barrels per day without assistance. It is growth associated with a 400,000 to 500,000 barrel per day industry which concerns us.

Impact Studies

There have been several studies which have attempted to examine the magnitude of the socioeconomic impact associated with the oil shale production industry within the Piceance Basin. A number of these are site and single-plant specific, examining the impact associated with a particular facility on a particular site. We have been unable to find a comprehensive assessment which examines the impact of all potential oil shale and energy development within that region and focuses on all elements of the analysis, that is, from technology deployment through definition of infrastructure support cost. Nonetheless, we can provide information which represents the most recent estimate of the socioeconomic impact for oil shale production within Colorado.

The Administration's current target for oil shale production is 400,000 barrels per day in 1990. The construction labor force required during the period 1980-1990, normalized to a 1990 production capacity of

400,000 barrels per day, has been estimated as 54,336 labor years of effort.

The total estimated operations employment over the same period, again normalized at 400,000 barrels per day production, is 57,114 labor years of effort.

This increase in population due to in-migrating workers also stimulates other population and economic growth. There are a series of multipliers which are used to estimate this growth. These multipliers are related to:

- Worker average family size.
- Indirect employment generated.
- Infrastructure support cost.

A wide range of multipliers have been used to estimate family size associated with these new workers. The multipliers found within related studies are as low as 1.2 and as high as 3.8. It is important to note that it may be especially appropriate to segregate estimated family size by the construction and operations phase. Construction workers and their families are often transients and do not establish permanent residence within the geographic area experiencing development. The average number of dependents per construction worker has been estimated as 1.2 per worker; that for operational workers as 2.4 per employee.

Secondary or indirect employment generated by the introduced oil shale industry is also represented by a range of multipliers. These multipliers are as low as 0.4 and as high as 2.0. Once again, as in the case of estimating associated family size, segregation of these multipliers for construction and operations is appropriate; the range of multipliers that we have seen for both categories is coincidental with the range mentioned above.

Based upon the use of these data, the range of total 1990 population growth associated with oil shale production in Colorado could range from 34,700 to 160,000. The range of values given in a survey of studies on population growth has been from a low of 54,719 to a high of approximately 85,382 for a normalized 400,000 barrel per day case. We have only seen one cost estimate for the related infrastructure support. This estimate was prepared by the Colorado State government, and represents the incremental per capita cost of infrastructure related to energy production. The cost estimate is $4,725 per person. This falls within a commonly used infrastructure support cost range which we have become familiar with of $3,000 to $6,000 per person that studies of other areas have estimated.

It may be demonstrative to use these multipliers in their extreme to calculate the range of infrastructure support cost which could result from their use. Chart 3 provides the particular multipliers used and the result. The calculated range is $100 million to approximately $1 billion, an order of magnitude difference.

Future Efforts

The information presented above demonstrates that there certainly is a fairly significant range of specific conclusions concerning socioeconomic impacts associated with oil shale production. Of course, as we move through the demonstration phase to commercialization for the actual facilities, we will learn more about the technologies and their associated impacts; mitigation plans can then be refined.

Our expectation is that these uncertainty ranges will become smaller between now and 1990. There are several reasons why these data ranges are broad. First, the oil shale technologies are still in their embryonic stage, and we still have yet to learn specific data about their construction needs and operating characteristics, including associated employment. The various multipliers mentioned above should become more specific factors as more is learned about the technologies and the geographic area's reaction. We feel that the growth pattern which will be experienced will not be similar to the "boom-bust" situation which often accompanies the introduction of a single plant within a rural area, but rather rapid growth maturing to continuing urbanization. As time passes, the exact patterns which we can use as a basis for forecasting will become evident.

We feel that there is a basic error in approach in attempts to estimate the required infrastructure support cost that causes an overestimate and that can be reduced by proper planning and management. As mentioned earlier, attempts in estimating this cost have pursued the path of estimating the incremental infrastructure support cost which would result from energy resource production with little regard to the revenue collection patterns. This method can be represented by Chart 4. It requires the comparison of the estimated infrastructure support cost for normal, non-energy related growth with the growth that would occur with an oil shale or other energy production industry introduced to the area. The incremental cost is calculated, divided by the incremental population growth, yielding a per capita cost for additional infrastructure support. It is our conclusion that the appropriate approach to take is to compare that incremental cost to the incremental revenue which would result from energy resource development.

The method suggested would require the estimation of incremental infrastructure cost and incremental revenue which would result from the placement of an oil shale production industry within the geographic area. A comparison of cost versus revenue can then be performed. Our estimation is that this area will most likely experience the type of behavior represented in Chart 5, which compares the relationship between cost and revenue. Early in the growth of the area, infrastructure support costs will most likely outpace available revenue. As the area becomes more urban and stable in character, the relationship will change; that is, revenue will outpace cost. Finally, as the area continues to grow, a diseconomy of scale may occur and cost will again and possibly always outpace revenue. This last stage is where most large urban areas within our nation find themselves today. Federal and state governments have existing mechanisms to assist these areas. The middle stage poses no revenue problem. The appropriate concern, then, is with the first stage of this relationship. The specific questions which require answers are: what is the magnitude of the cost/revenue differential, what period of time does it cover, and how can the revenue short-fall be compensated for? In short, this is the "up-front" revenue problem.

As one would expect, we, at the Department of Energy, are attempting to provide more definitive conclusions in this area. The Department is currently allotting approximately $2.5 million to local governments and institutions in the oil shale production area in this fiscal year in order to examine the related socioeconomic impacts at an even more refined micro-level. In order to be able to answer the detailed questions concerning the magnitude of impact, infrastructure support costs and the requirement for Federal assistance, more detailed assessment will be required. In response, the Department is currently planning to conduct a related carrying capacity assessment in conjunction with the Colorado State Department of Natural Resources, primarily focusing on air, land and water issues. Peripheral to this study will be a detailed socioeconomic impact assessment, using earlier assessments as a basis for a more quantitative, definitive conclusion.

I would now like to answer any questions that you may have.

CHART 1

IMPACT OF IMPOUNDMENTS ON RIVER FLOW

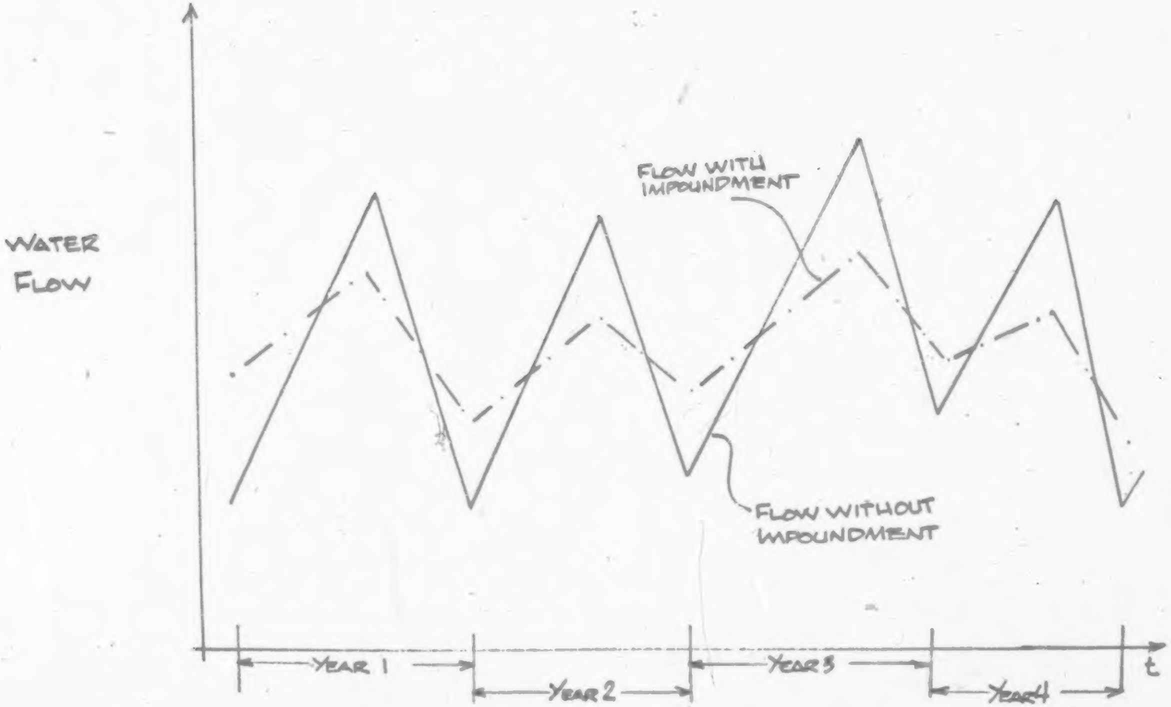


CHART 2

RELATIONSHIP OF INFRASTRUCTURE ASSESSMENT ELEMENTS

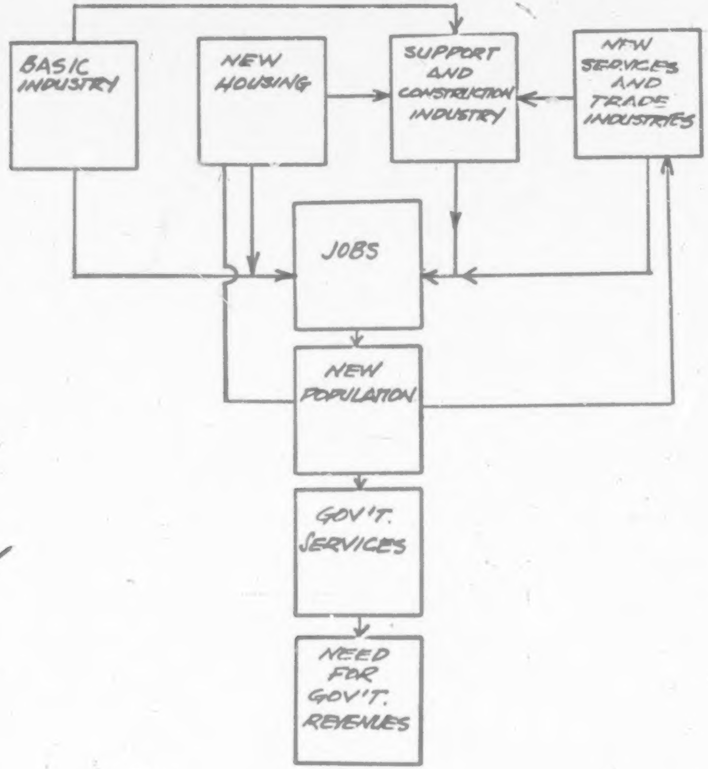

BASIC INDUSTRY
NEW HOUSING
SUPPORT AND CONSTRUCTION INDUSTRY
NEW SERVICES AND TRADE INDUSTRIES
JOBS
NEW POPULATION
GOV'T. SERVICES
NEED FOR GOV'T. REVENUES

CHART 3
RANGE OF INFRASTRUCTURE COSTS FOR PERIOD 1980 THRU 1990

	LOW CASE	HIGH CASE
EMPLOYMENT		
CONSTRUCTION	5433	5433
OPERATION	5712	5712
TOTAL (P)	11,145	11,145
MULTIPLIERS		
FAMILY (F)	1.2	3.8
INDIRECT EMPLOYMENT (I)	0.4	2.0
POPULATION		
DIRECT EMPLOYMENT	11,145	11,145
DIR. EMPLOYMENT FAMILY	13,374	42,351
INDIRECT EMPLOYMENT	4,458	22,290
INDIR. EMPLOY. FAMILY	5,350	84,702
TOTAL	34,327	160,488
PER CAPITA INFRASTRUCTURE $ (C)	3000.00	6000.00
TOTAL INFRASTRUCTURE $(S)	103. MILLION	963 MILLION

$$S = PC\left[(1+F)(1+I)\right]$$

Senator HART. Let's start on the other end and work the other way. Mayor Schultz?

CONSERVE AVAILABLE WATER FOR AGRICULTURAL USE

Mayor SCHULTZ. I'm glad to find out about how much water you're going to use and tying all this water up. I'm very concerned about our ranches. And, after all, I've come up to a long time of water, and it's very, very important that we're going to have more people every year and every year to be. And I think we should conserve our water and especially for agriculture even if we don't have energy, because we got to feed these people. And I know we're going to have to have energy, but we ought to put a lot of emphasis on agriculture and our water.

And another thing I was quite perturbed about was that all oil shale development in the Piceance Basin—where the deer run. And that's another source of food for the people in Rio Blanco County. You'd be surprised. You don't think nothing until you come over about the 12th or 15th of October. We'll see people from Texas, all over the United States. And it is quite a source of revenue besides food.

Outside of that, I think I'll pass, Senator.

Senator HART. Thank you.

Mayor Rector?

Mayor RECTOR. To be quite honest, I have no questions. I've sat with Wally over many water issues in Rangely. And with the problems we've had with who has the right to answer as far as the water supply for this powerplant, I would hope that some day all identities can get together and resolve it. But I would not anticipate it could be done within even 30 years at the rate we've gone on this issue. We've all worked terribly hard. But we've had within our own confines discrepancies. So I see it as a real difficult situation trying to get this transmission or water from one State to another. I don't know if that will ever happen.

Senator HART. Commissioner Schultz?

FEDERAL FUNDING FOR WATER STORAGE PROJECTS

Commissioner SCHULTZ. I would like to address one question to Dr. House. We get very frustrated I think on a local level. We see water hit lists out of Washington. We see different areas of the Federal Government that make different decisions. We see energy needs outlined in terms of barrels of oil shale that's needed. And yet we can't seem to get funding for water storage projects. Is it the Department of Energy? Is it the Department of Interior? Who is looking at some Federal aid and way to get these projects off dead center? And is there a way the different Federal agencies can come together and formulate a water plan we can work with in the West and develop this storage we so desperately need for agriculture as well as the development of energy?

Dr. HOUSE. I'm not exactly sure how to deal with that. I believe right now, if I could go back to my earlier testimony, the administration in looking at feasibility of synthetic fuels originally looked at the feasibility of a 400,000-barrel-per-day industry. I think it is pretty generally conceded for this first phase water is available.

As far as the long-range plans or plans for the rest of the Federal Government in terms of impoundments through such things as studies by the Water Resources Council and at the Cabinet level itself, I'm sure that these are talked about. But I have no other information on that, I'm sorry. I understand your problem. I just don't have any background for it.

INCREASED IMPOUNDMENT NECESSARY FOR SYNTHETIC FUEL DEVELOPMENT

Commissioner **Schultz**. I think the message has to be clear to the Federal Government that we plan on and will maintain a viable agriculture industry in this part of the State of Colorado; and in some way, shape, or form, we'll have to have additional storage and additional water to meet the energy needs. And it's one thing to come up with figures of numbers of barrels of oil that we'll have. It's something else to actually meet that goal. I think we have to work together to do that.

Dr. **House**. The estimates that I gave you today from the Water Resources Council study do recognize the need for more impoundments.

Senator **Hart**. I might say in this connection—I don't remember whether you were in my office that late evening with Congressman Aspinall and Governor Vanderhoof. I will say in Dr. House's defense he's not here in the policymaking capacity on what the Federal Government's administration's policy on increased water is. But the three of us had a chance I think to make a very fundamental point to the head of the President's domestic policy staff, and that was you don't develop synthetic fuels in northwest Colorado without increased impoundment. And as a result of that meeting largely, the Interior Department is in the process of reevaluating I think almost every federally appropriated or considered water project up to as many as a dozen on the Western Slope with a view toward the changed economics that energy requirements should make. And we should have the results of that shortly.

Commissioner Cerise?

Commissioner **Cerise**. I really don't have any questions. I'm sure that water is going to be very critical when it comes to the large-scale development we hear could happen. And I think it's something that's going to have to be addressed before the problem develops.

Senator **Hart**. Senator Soash?

REGULATIONS IMPEDE SYNTHETIC FUEL DEVELOPMENT

Senator **Soash**. Thank you, Senator. I have one question for Roland. And I think that everyone realized we've got to have storage if indeed we're even going to provide the water we need for a modest oil shale for the company municipal growth that would come with it. But even if the Federal Government would review, as Senator Hart indicates they are doing, the hit list projects and funding for that would be forthcoming, we're only looking at the difficulty you've all experienced with the Juniper Cross Mountain project and looking at some of the projects generated in the Missouri basin where one project took one permit and the present one they're considering is up in the hundreds of permits of building.

With these kinds of constraints, do you think we can in fact build those reclamation projects to store the water in a timely fashion so if nothing changed in the way of Federal and State policy, we could provide that water on a timely basis to this industry?

Mr. **Fischer.** Well, it's a very difficult question to answer. And I probably have some knowledge that's not well-known to the Senator or the panel. If the Endangered Species Act is enforced, following the *TELECO* decision in the U.S. Supreme Court, and in light of a meeting which has been reported to me which I did not attend, however, concerning biological opinions under the Endangered Species Act, section 7 thereof. The statement has been made by the Fish and Wildlife Service that any further depletions in the Upper Colorado River Basin will endanger the survival of the Colorado River squaw fish, ~~and they intend to~~ oppose.

The context of that was the city of Cheyenne to divert out of the Little Snake River. And I think it would take protracted litigation. The River District is presently suing the Secretary of the Interior over this question. And if a political biologist discovers an undiscovered plant or if there's a discovery of a peregrin falcon who thinks he might want to fly up Parachute Creek, he will get an adverse biological opinion. And I think the law is such that you will not reduce the consumption of water in the Colorado River Basin. I think there are those who would sue over that question on both sides of the issue, that at this point in time the Fish and Wildlife Service is oriented toward the estoppel of water resources used in the Upper Colorado River Basin. And I think they have a certain amount of clout, and I think they can almost get it done.

I would like to comment on Commissioner Schultz's inquiry, if I may, and that is that the 1956 and 1968 acts provide for the Upper Colorado River Basin fund to help fund the development of those water resource projects which are participating projects. That includes Savory Pothook, West Divide, Dallas Creek so that there is a funding mechanism in place. The development of water resources in western Colorado is not going to be a drain at all on the Federal treasury. Those cash register reservoirs, including Lake Powell, are using water that in part belong to the State of Colorado. That is what the legislation provides for.

So with that little inquiry, I hope I have answered Senator Soash's question. I think we're in a real crack.

COLORADO RIVER BASIN STATES WATER FLOW

Senator **Soash.** Just one other question, Rolly. How much water flows down the Colorado River Basin States?

Mr. **Fischer.** I don't know. I think that is an embarrassment for me to have to say I don't know.

Senator **Soash.** It is substantial, isn't it?

Mr. Fischer. Well, substantial. The boundaries of the Colorado River district which is the Yampa, the White, the mainstem Colorado, and the Gunnison contribute about 65 percent of the calculated virgin flow of the river. But Lake Powell did spill and spill this year, and thereby, the filling criteria at Lake Powell are terminated. And that means that the Upper Basin States no longer have to pay power interference to the Lower Basin States at Hoover. And it did spill.

Senator Hart. Representative Theos?

WATER AVAILABILITY GOVERNS DEVELOPMENT OF COLORADO

Representative Theos. Thank you, Senator.

I guess my question is—Tim asked it, but I'm going to ask it in a different way. I've always said that the size of development or how many people move into Colorado is the availability of water, how much water we're going to have. And I think that still bothers me. But I guess my question is and what's been bothering me is the acts that Congress and agencies have passed back there in Washington in the last few years such as RARE II—and this is something that hasn't been brought up here—80 percent of the testimony that came in from Colorado was against any more wilderness. Yet they passed more wilderness over there. And I think this is going to be something we have to live with.

Another one—and Monte's office didn't even know about the desertification study they were putting on there. And we didn't have any input in that at all. So don't you think that the reason we haven't got these water projects going or we're not going to get them going is on account of what's happening back in Washington with people that don't know nothing about what's going on out here in the West?

Dr. House. That's quite possible. But possibly the Department of Interior would be more able to answer questions about the water projects in discussion you just had, the RARE II, and the desertification study you're talking about. Those are outside the purview of the Department of Energy. If major studies like that are going on and there is no input from the areas that are most impacted, that seems to be foolish at best. But it's hard to judge.

Mr. Pascoe. Well, the reason that—Representative Theos knows I didn't know about the decertification study. I'm sure it's because Walt Youngland pulled up beside me and yelled to me on the street one morning and said, "What about all this?" And I said, "What are you talking about?" He said, "Well, I just got a call yesterday that this road show has been up in Idaho, and they are heading for Denver. I'm supposed to be upstairs at 9 o'clock." That's how we do get some of our information I do think, about 24 hours before the event.

Senator Hart. Representative Edmonds?

CAPABILITY OF ENERGY COMPANIES TO PROVIDE IMPOUNDMENTS

Representative Edmonds. Just to expand a little bit on Senator Soash's question. If the impoundments from the Federal Government aren't forthcoming or insufficient for the water needs for the oil shale industry—and I'm directing this question to both Wally and Monte—if we don't have enough dams, do you think that the energy companies themselves have the financial and the legal capabilities to build those dams?

Mr. **PASCOE**. Yes. No question about it. We build single-purpose reservoirs and they have the funds to do it. It's a relatively small part of a $4 billion budget.

Representative **EDMONDS**. One other quick question. One of the studies that I have seen by our Energy Research Institute indicates that farming would not be affected by the water needs of the shale oil industry until about the 400,000 or 500,000 barrel point. Is that in accord with what you know, Monte?

Mr. **PASCOE**. That's really what our figures show. Now, in fact the impacts will be felt earlier because of the purchase of water rights that are now being used for irrigation in some instances. But it's our hope that we could supply those water requirements from other sources and that we wouldn't have to turn to purchasing existing irrigation rights.

Representative **EDMONDS**. Thank you.

WHO SHOULD BUILD THE DAMS?

Senator **HART**. Beyond the question of whether private interests can afford to build structures is the policy question of whether they should. It seems to me that we have two choices; that is, dams can be built either by the Government, meaning the Federal Government, or by private companies. I don't want to state the case. I would ask first Messrs. Fischer and then Pascoe if the Federal Government builds a dam, isn't it more likely that it will be a multipurpose project with water for agriculture and municipal needs than if the private company builds a dam where its requirements are only for a single purpose; namely, energy development?

Mr. **FISCHER**. I'd like to comment and ramble a little bit.

Senator **HART**. Well, ramble briefly.

Mr. **FISCHER**. First off, I think certainly the State and the Water Conservation and Water Conservancy Districts can build those facilities and would probably in that case have a greater opportunity to insure multipurpose use. I think that the U.S. Congress when it decides to move could be just as single-minded as a private appropriator.

Now, bear in mind, single-purpose reservoirs have been built in Colorado for irrigation for over 100 years. Single-purpose reservoirs are not new. I think that the industry might be oriented toward single purpose. I think if the State and the local agencies were in there though, they could probably be persuaded to include multipurpose water uses. If I were management of a company, I would look awfully careful at the cost of that, at providing uses for other than what I wanted to use that water for.

Senator **HART**. So what you're saying is that local water districts might be the best protection for all potential users of the water?

Mr. **FISCHER**. Certainly. And specifically the Colorado River Water Conservation District.

Senator **HART**. This sounds like a commercial.

Monte, do you have any thoughts?

Mr. PASCOE. I doubt very much that the industry would build water storage projects for use by others. The margin of profit would be very narrow there. By tradition, it's been very narrow. There have been frequent subsidies of irrigation water for a number of reasons, and I don't think they would be in that business.

Senator HART. Yes, Mr. Schultz?

WATER FOR SMALLER COMMUNITIES

Mayor SCHULTZ. I'd like to ask these fellows, is there anywhere in this water study that these little towns we don't know how much impact we're going to get, how we're going to be assured water in the future?

Mr. PASCOE. The work that we've done—and I want to again emphasize the inability to work precisely with this information—but it does include a certain amount of water for smaller communities that would not necessarily be energy related. It could be just their ordinary future requirements for water supply.

TOTAL WATER REQUIREMENTS OF INDUSTRY

Senator HART. Let me try to put a sharper point on how much water is available. Can we get any kind of consensus on this, any range of consensus? I think I heard Mr. Slick say their estimates are there is sufficient water in the system to support an oil shale industry of 1½ to 2 million barrels a day without substantial negative impact on agriculture or other requirements and without going outside the basin.

No. 1, is that each of your understanding? And No. 2, if it's not, what is your understanding? Because I think I heard Monte say just dramatically the opposite a minute or two ago like 400,000 barrels.

Mr. PASCOE. Well, I used the number 500,000 to 700,000. If you use a few different assumptions, you can expand that range. If you go up to some of the high figures on the amount of water that would be used for 50,000 barrels' production or if you go to the low figures, you go up 100,000 or 200,000 or down a 100,000 or 200,000 of what can be produced. It's kind of middle range. It's also a middle range on our projections for what other uses are now decreed. We're not talking about things that might be used for which there are conditional decrees at this time but other uses now decreed and with senior rights in many instances to the oil shale industry that will need to play out their requirements over the course of the next 20 or 30 years.

Taking that into account, it would appear to us that a reasonable, prudent planning range is betwen 500,000 and 700,000 barrels per day. That differs from other numbers that have been used. It makes an enormous number of assumptions. It makes assumptions about what our obligations under the compact might be. It makes assumptions about where these uses will take place. But it does try to fairly evenly distribute the uses so that one part of the Colorado River system will not end up supplying all of our compact requirements. That's unfair, and it's probably something that could not happen anyway under the legal status of our water rights. But it's unfair for that to occur.

Senator HART. Rolly?

Mr. FISCHER. Senator, my work for OTA and messing around with the oil shale industry since 1955, I figure about 1 million barrels of crude shale oil per day could be accommodated with additional storage and not force that industry into impacting the agricultural community. That's a nice round number. I'm not sure if it's 1½ million or 750,000. I'm not sure anybody knows.

Senator HART. Dr. House, do you have anything to add to that?

IMPACT OF ACCELERATED OIL SHALE DEVELOPMENT

Dr. HOUSE. I'd tend to support the position that I'm not sure anybody knows. But, again, if you just take some of the numbers that we've found and purchasing water from existing reservoirs which are not in use now, one of the numbers we have is upward of a possibility of 500,000 acre feet per year. If you look at the so-called accelerated level of oil shale development of 1.7 million barrels a day, at least in the earlier studies, this is possible from flow, given more impoundments.

If you look at the OTA study of mining ground water, which can go up as high as 1 million barrels a day, I don't know how you add across that. Nobody has said what's the impact of one of these on another. There is no study to that effect. It seems to me that just looking at those numbers there, that someplace between 1 million to 2 million barrels a day could be reached. But I'm sorry, it has not been done. It would require a detailed study to do it. We need a study to look at each one of these segments, and it's not been done.

REMOVE LEGISLATIVE BARRIERS TO SYNTHETIC FUEL DEVELOPMENT

Senator HART. Let me just make two other brief observations in response to observations others have made, first to Nick. The wilderness legislation, which Congressman Johnson, Congressman Kogovsek, Senator Armstrong, and I have supported and without our support would not have been passed, will in no way affect the oil shale development at all, period.

Two, Rolly, on the endangered species, this country's demand for energy is not going to be stopped by what you call political biologists or chubs or squaw fish. The law has to be changed, and the law will be changed. I don't think people ought to believe that the security, economic or national or military of this country, is going to be stopped by that. The law will be changed first. And no biologist in the Interior Department buried away is going to prevent the development of the synthetic fuels industry.

Nick?

Representative THEOS. I'll come back to you. You say that RARE II is not going to hurt the development of oil shale and water projects. Well, the more land that you set aside for one use, the less land you have to do something with.

Senator HART. I understand.

Representative THEOS. And that isn't the only one that's worrying me. It's the one coming up. You're going to have another surprise coming out of Washington, RARE II on the BLM lands. And I think this is what they're talking about transferring water from the Missouri River over here. The Mississippi is going to be coming through

CHART 4

INFRASTRUCTURE COST COMPARISON

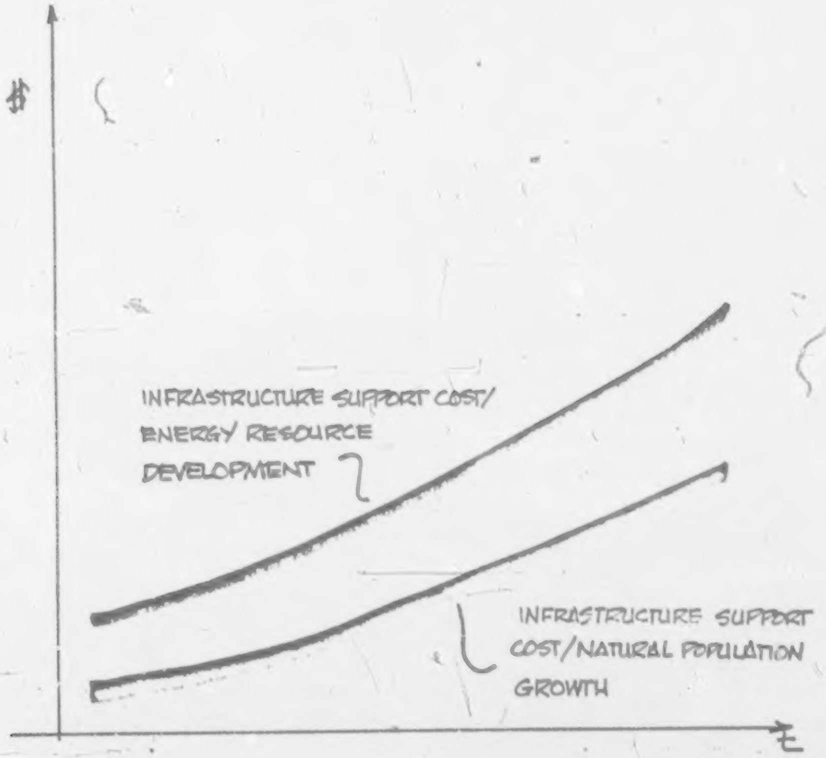
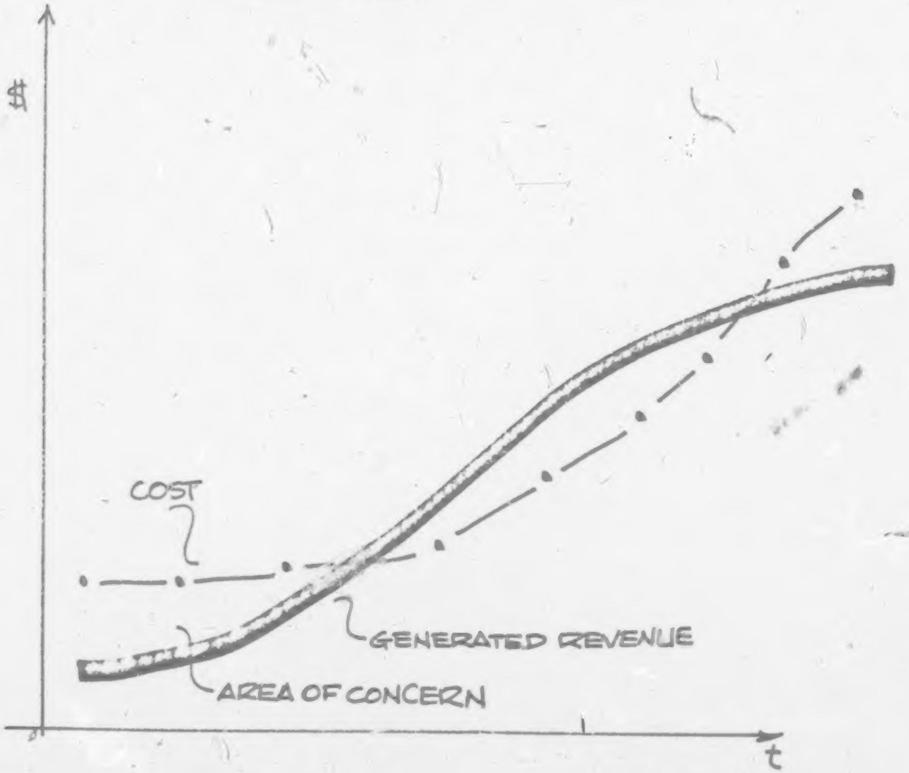


CHART 5

RECOMMENDED INFRASTRUCTURE COST COMPARISON



some of those lands that are going to be under wilderness consideration. And I hope you come up with less wilderness acreage next time than you did last time.

Senator HART. We came up with 700,000 or 800,000 acres less than the President, Governor, and the Forest Service wanted this time.

Representative THEOS. That wasn't much of an act to follow.

Senator HART. Are there any other questions of this panel?

[No response.]

Senator HART. If not, we have two other panels, one on air quality and one on community impact. We were going to break at 12:30. It seems to me we might take a 15-minute break right now and come back at 12:15 for the air quality panel, if we could do that, if that's agreeable.

[Whereupon, a brief recess was taken.]

Senator HART. Ladies and gentlemen, I want to apologize for the kind of forced march we're on here and a very shortened lunch hour. Presently you'll see those of us up here on the platform munching away on sandwiches if we're lucky. I hope the rest of you at least had a chance to get out and put an order in or send a friend over to get something to eat or whatever. But we're trying to cover a lot of ground here today in a relatively short period of time. And, of course, I let it slip a little bit behind.

So we'll proceed with our second panel which has to do with air quality. And we'll hear in this order from Mr. Rodney Slifer from the Colorado Association of Ski Towns; Mr. Terry Thoem of the United States Environmental Protection Agency; and Mr. Kevin Markey from the Friends of the Earth.

Senator HART. Mr. Slifer.

STATEMENT OF ROD SLIFER, PRESIDENT, COLORADO ASSOCIATION OF SKI TOWNS (CAST)

Mr. SLIFER. Thank you, Senator.

Senator HART. I urge all of you to speak as forcefully as you can directly into the mike. We have a very good sound system here and we just want folks in the back to be able to hear.

Mr. SLIFER. My name is Rod Slifer, president of the Colorado Association of Ski Towns. I'm also the mayor of Vail.

CAST represents the towns of Avon, Breckinridge, Crested Butte, Frisco, Mount Crested Butte, Silverthorne, Snowmass Village, Telluride, Vail, Winter Park, and the cities of Aspen and Steamboat. We're expanding our membership to towns affected by the offsite development impact which will include some of the other towns in our area. We predict to have about 20 cities and towns in our membership at the end of the year.

SPECIFIC CAST CONCERNS

CAST believes that air quality standards should be of such a nature that none of the residents in the communities we represent, or the environments on which our economies depend, are adversely affected. We believe in the preservation of class I air quality standards for our wilderness areas. We know that air quality standards could be adversely affected in western Colorado without continued diligence by

State and Federal Governments and private industry. This could, in turn, adversely impact our residents as well as our economies which, to a considerable degree, are built upon the clean air concept. A brown cloud will not add to the skiing experience.

We share the same concerns that were mentioned in regards to water. I'll not talk to that.

ECONOMIC IMPACT ON RECREATIONAL AREAS

A burgeoning western slope population will probably require a forest service in the State of Colorado to reexamine their policies and long-range planning efforts with respect to the expansion of existing ski areas and the granting of special use permits for new ones. The additional population on the western slope would undoubtedly put added pressure on existing ski areas and other recreational areas and uses. It is likely that the economic bases of some ski communities, currently highly dependent upon the destination skier market, would experience a shift in economic reliance to day skiers.

As a result, such communities would need to make major adjustments in their economies and the services they provide. The lack of income produced by the absence of the destination skier market will make it impossible for resort communities in future years to replace or build roads, water treatment plants, maintain air quality, and other needed capital improvements. It will also deplete our contribution to the State's welfare.

Social, economic, and biophysical impact assessments should be made for the entire western slope, not just the northwest corner or individual locales on a piecemeal manner. While it is important to assess primary impacts on the communities and regions immediately affected, CAST believes that energy development on a mass scale should be assessed for a much broader geographical region.

The pace is also important. I think that also has been addressed.

NATIONAL ENERGY DEVELOPMENT POLICY

We feel a national energy development policy should be adopted by Congress to assure that energy resources on the western slope will be developed in a timely, orderly, and well-planned fashion. A national policy, in turn, will allow western slope local governments to establish comprehensive planning programs to meet projected social, economic, land use, and biophysical environmental demands caused by resource development.

From a local government perspective, we believe that a national energy policy should include a provision for financial and technical planning assistance for local and State government; passage of Senator Hart's energy impact assistance bill to assist local governments in obtaining loans for needed capital expenditures; untangle the overlapping and often contradictory and confusing authority of various Federal agencies which have permitting authority over energy projects.

We do not believe that it is necessary to create an Energy Mobilization Board to overcome these problems and act as an ultimate referee. Our experience indicates this type of problem is not solved by superimposing another layer of administration.

WESTERN SLOPE PLANNING PROJECT

CAST advocates a western slope planning project similar to the concept of the front range project currently underway with funds provided for local and regionwide planning. Government, industry, and citizens should participate. We realize that public planning per se has traditionally gone against the grain of the western frontier ethic in Colorado but we may become the world focal point for energy development during the next 20 to 40 years. It would be shortsighted not to recognize the potential and prepare ourselves accordingly.

Colorado ski communities are no strangers to significant population, environmental, and financial impacts. Some of us have been blessed with the financial and human resources to cope with these impacts. CAST is interested in assisting sister communities which may be experiencing or will be experiencing massive impacts in the future.

We believe that forums such as this are invaluable, not only making CAST's view known to Congress, legislators, and fellow residents on the western slope, but also as a way to show our concern for Colorado as a whole and the western slope and its communities in particular. We offer to individual communities and this panel whatever assistance, expertise, and insights CAST might possess with respect to the impending energy boom on the western slope. This is done in a spirit of enlightened self-interest.

How well we do may depend on how well and how soon we can prepare, build, and plan for our future. We do not want to abdicate responsibility to the State and the Federal Government.

It appears to us that it's obvious that offsite and human impacts have not and are not being fully addressed. By offsite impacts, I mean the entire western slope. In the ski areas, we have really seen the effect of offsite impacts. The creation of a ski area creates a tremendous offsite impacts in other communities in tremendous ways. The county commissioners that are sitting here can attest to that. Those impacts are housing, transportation, social services, schools, labor, supplies, just to mention a few. The other impacts of air and water I think are being addressed by technical people who can address those far better than I. Thank you.

Senator Hart. We're very big on titles here, Mayor. So I apologize for not acknowledging yours.

Mr. Slifer. That's all right.

Senator Hart. Thank you very much for your statement.

Prepared Statement of Rod Slifer, President, Colorado Association of Ski Towns (CAST)

My name is Rod Slifer, President of the Colorado Association of Ski Towns (CAST). CAST represents the Towns of Avon, Breckenridge, Crested Butte, Frisco, Mount Crested Butte, Silverthorne, Snowmass Village, Telluride, Vail and Winter Park, and the Cities of Aspen and Steamboat Springs. We appreciate the opportunity to contribute to your hearing, and would like to present some specific concerns of CAST, as well as some more general concerns.

SPECIFIC CAST CONCERNS

Air Quality: CAST believes that air quality standards should be of such nature that none of the residents in the communities we represent, or the environments on which our economies depend, are adversely affected. We believe in the preservation of Class I air quality standards for our wilderness areas. We know that air quality standards could be adversely affected in western Colorado without continued diligence by the state and federal governments and private industry. This could, in turn, adversely impact our residents as well as our economies which, to a considerable degree, are built upon the clean air concept.

Water and Water Quality: CAST is concerned that the western slope may lack the water to meet the required industrial, recreational, agricultural, and domestic needs of the area.

Water quality must be maintained, but we do have concerns that sufficient high quality water will be available to dilute the inevitable pollutants caused by energy development and by increased populations on the western slope. Again, this specter concerns residents of our towns and may impact our economic base.

Economic Impact: Recreational Areas: A burgeoning western solpe population will probably require the Forest Service to reexamine its policies and long-range planning efforts with respect to the expansion of existing ski areas, and the granting of special use permits for new ones. The additional population on the western slope would undoubtedly put added pressure on existing ski areas and other recreational areas. It is likely that the economic bases of some ski communities, currently highly dependent upon the destination skier market (Aspen, Vail, Snowmass, Crested Butte, etc.), would experience a shift in economic reliance to day skiers. As a result, such communities would need to make major adjustments in their economies and the services they provide. The income produced by the destination skier market will make it possible for resort communities in future years to replace or build roads and water treatment plants.

GENERAL CONCERNS

Western Slope Impact Assessment: Social, economic and biophysical impact assessments should be made for the entire western slope, not just the northwest corner or individual locales in a piecemeal manner. While it is important to assess primary impacts on the communities and regions immediately affected, CAST believes that energy development on a mass scale should be assessed for a much broader geographical region.

Phased Development/Phased Response: The pace of industrial energy development needs to be identified so that impacts can be projected, and appropriate responses and mitigation measures can be made in accordance with this development schedule.

National Energy Development Policy: A national energy development policy should be adopted by Congress and the President, to assure that energy resources on the western slope will be developed in a timely, orderly, and well-planned fashion. A national policy, in turn, will allow western slope local governments to establish comprehensive planning programs to meet projected social, economic, land use and biophysical environmental demands caused by resource development.

From a local government perspective, we believe that a national energy policy should include the following:

A. Provision for financial and technical planning assistance for local and state government.

B. Passage of Senator Hart's energy impact assistance bill to assist local governments in obtaining loans for needed capital expenditures.

C. Untangle the overlapping, often contradictory, and confusing authority of various federal agencies which have permitting authority over energy projects. For example, the Department of Energy, under the Energy Security Act, has the responsibility of framing synfuel production goals for the 1980's. The responsibility to grant leases and assess impacts rests with the agency charged with administering federal land. In many cases, this will be the Department of Interior. It is possible that production goals would not be met because leases or permits could not be obtained.

We do not believe that it is necessary to create an Energy Mobilization Board, as President Carter has proposed, to overcome these problems and act as an ultimate referee. Our experience indicates this type of problem is not solved by superimposing another layer of administration.

Such problems, if they are unresolved, directly impact local governments which are left not knowing how and when to plan for and meet the impacts on their housing stock, social systems, economic frameworks, and environments. The entire western slope and the State of Colorado can also be victimized by this same uncertainty.

While pure economics will probably be the determining factor with respect to the timing and extent of synfuel development, what is needed now is a decision to straighten out the review process. We are certain this would also be welcomed by industry, as well as local government.

Western Slope Planning Project: CAST advocates a western slope planning project, similar to the concept of the Front Range Project currently underway, with funds provided for local and region-wide planning. Government, industry and citizens should participate. We realize that public planning, per se, has traditionally gone against the grain of the western frontier ethic in Colorado, but we may become the world focal point for energy development during the next twenty to forty years. It would be folly not to recognize this potential and prepare ourselves accordingly. An overall national energy plan is central to effective western slope planning.

Colorado ski communities are no strangers to significant population, environmental and financial impacts. Most have been blessed with the financial and human resources to cope with these impacts. CAST is interested in assisting sister communities which may be experiencing, or will be experiencing, massive impacts in the future.

We believe that forums such as this are invaluable in not only making CASTs view known to Congress, legislators and fellow residents on the western slope, but also as a way to show our concern for Colorado as a whole, and the western slope and its communities in particular. We offer to individual communities and this panel whatever assistance, expertise and insights CAST might possess with respect to the impending energy boom on the western slope. This is done in a spirit of enlightened self-interest. How well we do may depend on how well and how soon we can prepare, build and plan for our future. We do not want to abdicate responsibility to the state or federal government in the emerging drama of western Colorado. Our communities will be affected, and we are vitally interested. We believe that local government must take an active part in framing the future of the western slope and Colorado.

Senator HART. Mr. Thoem.

STATEMENT OF TERRY L. THOEM, DIRECTOR, ENERGY POLICY COORDINATION OFFICE, ENVIRONMENTAL PROTECTION AGENCY, REGION VIII

Mr. THOEM. Thank you, Senator and members of the panel. It is my pleasure to appear to present EPA's testimony on pace level development of oil shale in western Colorado.

EPA has supported and continues to support some level of oil shale development in the State. We've stated that in the past, and we continue to state that. We think that there are advantages to an orderly approach toward that development. In fact we see some environmental advantages to oil shale development versus some of the other synthetic liquids, both in the process as well as the end product that's produced.

As a final sort of philosophical note, we have indicated that we feel development of an industry about 400,000 barrels a day by the early nineties is a reasonable goal and is something we could be comfortable with.

AIR QUALITY

Addressing some specific air quality impacts, at the Denver hearing I presented the map in front of you that showed the geographical extent of some of the violations that we would prevent that would result from a large industry. And all my comments now will address that large industry, essentially an 8-million-barrel-a-day industry.

The zone of influence is shown by pollutant on this map showing the zone of influence where you would have violations of the primary health standards. And I would emphasize that these are the health standards. These are set levels to protect public health. They're to prevent pulmonary and respiratory problems in citizens of the country.

We did conclude that there was a zone of influence of violations of standards. In some of the questions that were addressed to us by you, we were asked about the magnitude of those violations as well as some more detail on where those violations would be occurring. We have done that followup study and it is presented in the testimony on the last four pages of the statement. It does show that we have violations of some of the health standards on down into the Rifle-Glenwood Springs area, the Colorado River Valley looking at the White River Valley up toward the Rangely area and over in the Utah area about 40 or 50 kilometers downwind from oil shale development.

We've also plotted on there where we would see compliance and violation of some of the other standards that are in the Clean Air Act and that EPA administers such as the prevention of significant deterioration.

We pointed out also in our Denver testimony that we did not consider the impacts of population, the air quality impacts resulting from that population growth. We undertook at study and a couple major points I should point out, one, is that we found that some of the pollutant impacts are not as dramatic as we would have expected. In fact, they are much less. Part of the reason for this is some of the pollutants that will be emitted from urban population centers tend to combine with some of the pollutants from the industrial facilities, thus lessening the impact of some of those pollutant concentrations. I don't want to go into any more detail than that, but it just shows that there are a lot of atmospheric chemistry going on that we have to worry about when we do these modeling studies.

The point is that we did find when we looked at about a 3-million-barrel-a-day industry and about 600,000 people in the Colorado River Valley, the Rifle to DeBeque area, that we did approach the ozone health standard, and we did show exceedences of nitrogen oxide health standards. In fact to underscore that, we even found higher concentrations at lower size industry. At a million-barrel-a-day industry, for instance, we got higher ozone concentrations.

EMISSION DENSITIES

I'd like to maybe cast a lot of the modeling uncertainties and modeling studies in fact almost out the window, because there has been so much criticism about that modeling. I think a good perspective is to compare the emission levels and emission densities from the industry and its associated population with some of the known areas like the Denver's and like the northeast, the New Jersey-New York City area. We know that air quality concentrations are being experienced in those areas. And when we make those comparisons between emissions, we find for instance 15 times the amount of nitrogen oxides emissions coming from industrial facilities, 8-million-barrel-a-day compared to a Denver. We find 2½ times the nitrogen oxides in particulate concentrations from an industry and its associate growth compared to some of the New England area, New York, New Jersey.

We don't need modeling studies to tell us what that result in air quality is going to be like. We know from actual monitoring, from visual observations. You know what that air quality is going to be like resulting from that size of an industry.

VISIBILITY

Let me turn your attention to another concept, that being visibility. To date, I've been talking about the health standards. Visibility I think is important, maybe appropos today, since I understand Governor Lamm has delcared this weekend as visibility weekend to try to draw attention to the good air quality and good visibility we've got in the State. Again, we made some very quicky preliminary calculations, and we found that with an 8-million-barrel-a-day industry, you reduce visibility throughout this area, Rifle, Meeker, Rangely, Grand Junction area, to less than 12 miles; 12 miles may be satisfactory for Chicago, but again to put in perspective, the person in Silt could not see Angle Points on a number of days. And I think those sort of perspective comparisons are what's important.

TECHNOLOGY SOPHISTICATION

Senator HART. What do you assume as to the degree of sophistication of technology? You say no improvement over the present technology?

Mr. THOEM. That is correct. And that has been mentioned. It would be very easy for us to almost give you a nonanswer and say that we really don't know what the year 2000 is going to look like. So we've got to base all of our emission estimates based on first generation type oil shale technology, first generation type pollution control technology. However, I should very quickly point out that that first generation pollution control technology is very, very good. We in issuing some permits to the Colony project—they are going to recover 99.6 percent of the sulfur in that facility.

Now, you can make arguments that you can go better than 99.6, but there's not a whole lot of room there. Same way on particulate control. All of the particulate emission are 99.8 to 99.9, 99.7. So while I may have some optimism that second generation oil shale technology will result in cleaner processes, I'm not as optimistic as some of the other people that have made comments that air pollution control technology is going to get dramatically better and that these results are going to be dramatically lessened.

LARGE SYNFUELS INDUSTRY WOULD DEGRADE AIR QUALITY

I would just point out that some of the statements made earlier about the skiing and the tourism, the hunting in the western part of the State, obviously is important. And I feel that people pressure as well as the degraded air quality, both decreased visibility, as well as we know with an 8-million-barrel-a-day industry, there will be a brownish cast to the air over the area. And I question how willing people are in western Colorado are going to be to accept that.

I conclude with maybe some comments, again trying to get at the answer that I know you're seeking, Senator, on what size of an industry could be acceptable, given present-day constraints. And I have to point out that these are given in the spirit of this is some prospective. These are certainly not decision-type numbers or final-type numbers. They're planning numbers. They're making estimates with kind of a best judgment and with what we've got to deal with today. Just as Mr. Pascoe has mentioned that additional detailed studies in water need to be done, certainly additional detailed studies in air need to be done.

But the conclusion is, as I mentioned, we are comfortable with the 400,000-barrel-a-day industry. We don't see air quality violations at that level. When we get up to about 8 million barrels a day, we start seeing probably violations of the ozone health standards. We probably see violations of particulate matter class II. We probably see violations of the class I increments. When we get up to the 3 million barrels a day, we see violations of the ozone and the nitrogen oxides health standards. We also see violations of the particulate matter, class III, if there were a redesignation to class III. And, finally, when we get to 8 million barrels a day, we see that's off, that all standards are blown. Thank you.

Senator HART. Thank you, Mr. Thoem. I want to come back in the question period to those levels you just stated, because I want to make sure I got the numbers right.

PREPARED STATEMENT OF TERRY L. THOEM, DIRECTOR, ENERGY POLICY COORDINATION OFFICE, ENVIRONMENTAL PROTECTION AGENCY, REGION VIII

It is my pleasure to provide EPA's input to this second hearing on the pace and ultimate level of oil shale development in Western Colorado and Northeastern Utah. It is very appropriate to hold this hearing in Rifle, the center of potential oil shale development. EPA has, since we were created ten years ago, advocated that some limited development of oil shale proceed. We still maintain the philosophy that a mix of technologies should be investigated in order to determine the optimal mix for an industry. The Prototype Oil Shale Leasing Program was and remains to be a good framework for the industry, government and the public to evaluate the positive and negative aspects of the development of oil shale. Advantages to an orderly development approach accrue to all sectors. Industry can iron out technological flaws at an early stage and can better design commercial facilities. Industry and the financial community can better define the capital and operating costs associated with oil shale production. Industry, regulatory agencies, and environmental organizations can more accurately quantify waste streams and their impacts on the environment.

At the outset, I want to stress our support for the goal of 400,000 BPD shale oil production in the early 1990's established by the President and Congress. It appears that this level and pace can be accomodated without jeopardizing existing environmental requirements and values.

The ever-growing burden of our oil imports price tag has prompted government action culminating in enactment of the Energy Security Act. DOI is also proceeding with the design of a permanent leasing program. Our testimony today emphasizes the air quality impacts associated with an oil shale industry. Water quantity/quality, solid waste handling, and people impacts of a massive 8 million BPD industry are also discussed. This discussion assumes that all 8 million BPD would come from the Piceance and Uintah Basins.

I must acknowledge however that the 8 million BPD scenario which I am about to discuss involves environmental impacts far in excess of those envisioned for the aforementioned 400,000 BPD program.

Air Quality

Our testimony at the July 17 Denver hearing provided estimates of the air quality impacts associated with the facilities associated with an industry. Our testimony today reports on additional air quality modelling which we have performed regarding the impacts of the associated population growth.

An 8 million BPD industry would cause violations of existing health standards for photochemical oxidants, particulates, sulfur dioxide and possibly nitrogen oxides. This conclusion results from preliminary regional modelling studies performed for and by EPA. Figure 1 attached to this testimony shows the geographical extent of the predicted violations. Violations of the particulate matter and sulfur oxides standards will occur about 15 to 20 km beyond the development areas. However, the summary provided in Figure 1 underestimates the impact of SO_2 and particulate emissions because of the modelling technique used. Values which are being considered for a short term nitrogen oxides standard would be exceeded throughout the Piceance and Uintah Basins. It can be seen that violations of the ozone standard would be predicted throughout the entire study area. Several factors suggest that these results underestimate the impacts which would be expected.

1. A neutral (D) stability was used in the modelling study which represents good dispersion conditions. Much higher concentrations will occur frequently during the fall and winter due to the prevalence of inversion conditions which occur in the mountain valleys throughout both the Piceance and Uintah Basins.

2. Particulate emissions will increase if surface mining is used.
3. The SO_2 emissions may even increase unless the very stringent controls which Colony employed are provided. Occidental Oil Shale Inc. is proposing less control.

The existing concept of Prevention of Significant Deterioration of Air Quality (PSD) has been established by Congress and confirmed by the Supreme Court. The National Parks and Wilderness Areas shown on Figure 1 have been designated for special protection (Class I areas). All other areas are classified as Class II. An 8 million BPD industry could cause Class I violations at most Class I areas shown on Figure 1. Class II violations could occur out to distances of at least 50 km from the development areas (e.g. about as far as Glenwood Springs).

The population impacts do not contribute as significantly to the industry impacts as we had expected. Several factors account for this. First, automobile emissions associated with the population increase were assumed based upon the year 2000 when vehicle emissions will be significantly lower than the present day vehicles. Even Denver may enjoy clean air in 2000. Also, there is a unique interaction which occurs between the industrial air pollutants and the population center pollutants which reduces the ozone impacts. The NO emissions associated with the industry and population tend to combine with any produced O_3 to form O_2 and NO_2. This atmospheric chemistry reaction of course produces more NO_2 and hence will produce a yellowish-brownish cast to the sky.

Attempts to predict ambient concentrations are associated with uncertainties. Perhaps a better perspective of the magnitude of the air quality impacts may be gained by making a number of comparisons. Knowledge of air quality situations in highly urbanized and industrialized areas, coupled with a comparison of their emissions with those from an 8 million BPD provide a perspective. Table 2 provides total emissions and emissions densities of an 8 million BPD industry compared with a number of Air Quality Control Regions. Some of the more graphic comparisons are . . .

Emission Densities

- PM	Oil Shale	2X	NY NJ Conn AQCR
	Oil Shale	15X	Denver
	Oil Shale	2 1/2X	NY - DC coast
- NO_x	Oil Shale	2 1/2X	NY NJ Conn AQCR
	Oil Shale	15X	Denver
	Oil Shale	5 1/2X	NY NJ Conn AQCR
- SO_2	Oil Shale	=	NY NJ Conn AQCR
	Oil Shale	8X	Denver
	Oil Shale	=	NY - DC coast

An additional perspective may be gained by comparing the particulate emissions from an 8 million BPD industry to all coal fired power plants projected for construction in the U.S. between 1980 and 2000. They are essentially equal.

Further perspective on the air quality impacts may be gained by a discussion of the visibility impacts which would be associated with an 8 million BPD industry. Calculations show that visibility would be reduced to less than 12 miles (20 km) throughout the entire area. Furthermore, the NO_2 concentrations would result in significant atmospheric discoloration (a color difference change of at least $\Delta E = 34$).

Another air quality impact which cannot be quantified at this time is the effect of the nitrogen oxides and sulfur oxides emissions on precipitation quality. The question has been raised as to whether the production and use of synfuels will add to the acid deposition problem. Not enough is known presently about the overall effects of synfuels production plants for us to make a specific projection of their effect on acid deposition. The emissions from uncontrolled or poorly controlled synfuel plants could worsen our deposition problems. It is clear that new synfuel production plants must be built in a manner which minimizes adverse impacts on our environment. In terms of the use of synfuels it is heartening to note that many of the products will be free of large amounts of sulphur. Also, due to the technology of the retorting process, organic compounds may be emitted. The characterization and effect of these pollutants has not been adequately performed since there are no operating oil shale facilities.

Water Quantity/Quality

It takes 4 barrels of H_2O to produce 1 barrel of oil. An 8 million BPD industry would consume more than 1.6 million AFY. If all of this requirement were to come from the Colorado River, it would represent more than 10 percent of the Colorado River's mean annual flow. The consumptive use of this amount of high quality Upper Colorado River Basin water could translate into a salinity increase of as much as 80 mg/l. Salinity increases result in economic costs in the form of crop yield reductions, additional scaling and corrosion, use of additional soap, etc. At $450,000 per mg/l, this translates into a cost of more than $30 million per year to downstream users.

If Missouri River water were used, the pumps to transport the water would need electricity from a 3000 MW power plant. This size plant would demand the fuel equivalent of a 150,000 BPD oil shale facility.

Additional reservoir capacity would be required. In order to assure a safe supply of water, as much as 3 million acre feet of storage capacity would probably be required. This is more than three times the size of the three Gunnison River reservoirs of Blue Mesa, Morrow's Point, and Crystal. It is equal to a Flaming Gorge.

As with the air quality analysis, this water discussion has not considered the needs and implications of an additional 1.7 million people. The cost of wastewater treatment facilities alone could be more than $500 million. Additional costs would be incurred for drinking water systems and fire protection needs.

Other water quality impacts resulting from an 8 million BPD industry which cannot be quantified at this time include:

1. Long term base flow reduction due to ground water withdrawal.
2. Increased stream concentration of F, B, NH_4, and TSS due to mine dewater discharge.
3. Increased inorganic salts and organic material in the ground water and surface water due to spent shale leachate.
4. Increased organic concentrations in surface streams due to spills resulting from the operation of the equivalent of four Alaska pipelines.

Solid Waste Handling

Hazardous and solid wastes will be generated by an oil shale industry. Assuming that all spent shale is disposed of above ground, the acreage required for spent shale disposal from an 8 million BPD industry would be a nearly 3000 acre pile as tall as the Anaconda Tower Building (about 400 feet) every year during the entire operational life of the industry.

The logistics of mining the necessary shale to produce 8 million BPD of oil are staggering. About 3.2 billion tons of average grade (32 gpt) shale would have to be mined each year. This is more than 4 times the total coal mined (770 million tons) in the entire United States in 1979. The logistics of providing equipment and a labor force of that magnitude in a small 50 mile by 50 mile portion of Western Colorado are staggering. Another perspective may be gained by comparing the required mines to existing open pit copper mines. If all mining were performed via the open pit method, the equivalent of about 80 Bingham Canyon mines would be needed.

People

An 8 million BPD industry would demand a continuous operational work force of more than 160,000. Coupled with families and induced support population, the population of Western Colorado and Northeastern Utah would increase by about 1.7 million if we assume a multiplier of 10.6 people per permanent full-time employee. The buildup to 1.7 million people over a 20 year time period would mean an increase of more than 80,000 people per year. That rate of increase per year is more than five times the present total population of the 4 county oil shale study area. Besides the air and water quality implications, this new population center would create extensive street, highway, transportation, and other public service demands. It would add extensive pressure to the recreational attributes of the Western Slope, i.e., hunting, fishing, and skiing. Added to the people pressure on the deer and elk herd of the Western Slope would be the mere presence of 160 oil shale plants like Colony in the Basin. In order to physically accomodate this number of facilities, they would have to be placed on five mile centers.

Conclusions/Recommendations

There are numerous unanswered questions associated with oil shale development. Because no commercial plants have yet become operational, there is little operational quantitative data which accurately describes the expected type and magnitude of emissions, water effluents, and solid waste. Accurate comparisons among mining and retorting technologies are not possible. It is our opinion that answers to these broad questions and many specific questions which we have posed in previous presentations should be obtained while oil shale development proceeds to a modest level. Based upon the answers obtained, the size and mix of technologies which would constitute an optimal industry could be decided. Although there is an abundant resource available, proceeding too quickly toward oil shale development may result in inefficient use of the resource, severe environmental degradation, or mandate expensive retrofit controls. Despite the reasonably good baseline data gathering efforts by industry and government and attempts by the developers to conduct operations in an environmentally conscientious manner, there have still been some surprises. These include 1) extremely higher than anticipated amounts of ground water, 2) extreme variations of sulfur composition of retort offgas, 3) water discharges in excess of NPDES limits, 4) ignition of raw shale/processed shale fines, and others.

Several aspects associated with oil shale development need attention if oil shale development proceeds in a manner which is not only good for the country but also right for Western Colorado and Northeastern Utah. These include . . .

1. Accurate characterization of waste streams.
2. Development of proper analytical tools to predict the cumulative impacts associated with a large industry.
3. Investigation of the ability to use low quality water in the process.
4. Assessment of the effectiveness of conventional environmental control technologies.
5. Development of a mechanism to provide planning, financial, and technical assistance for community service needs.

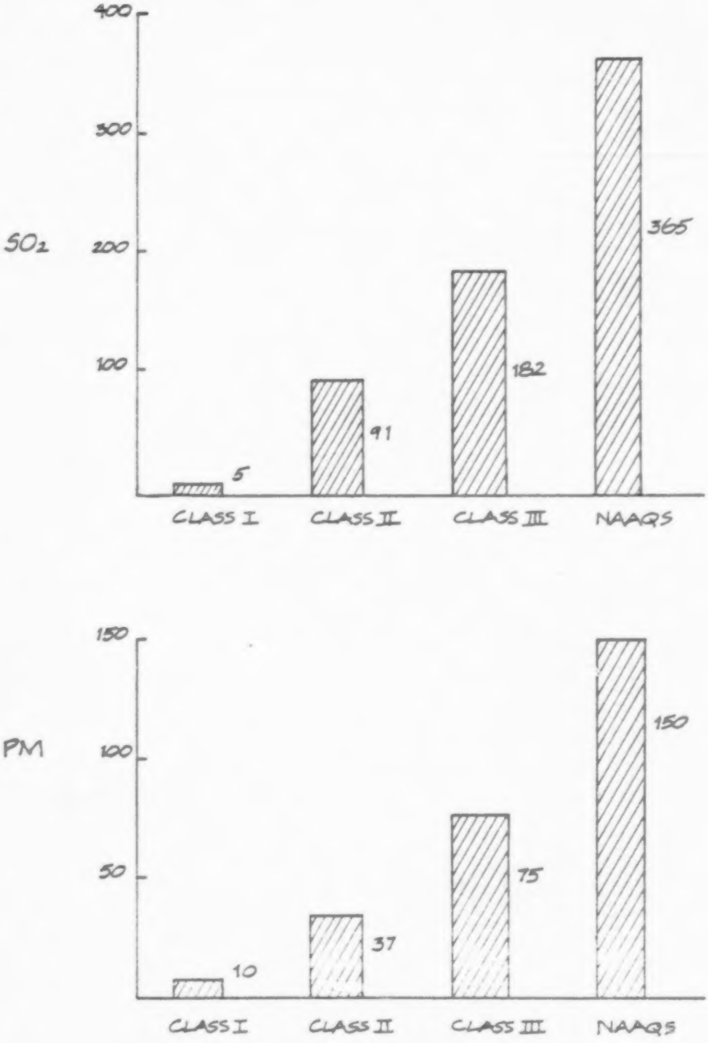
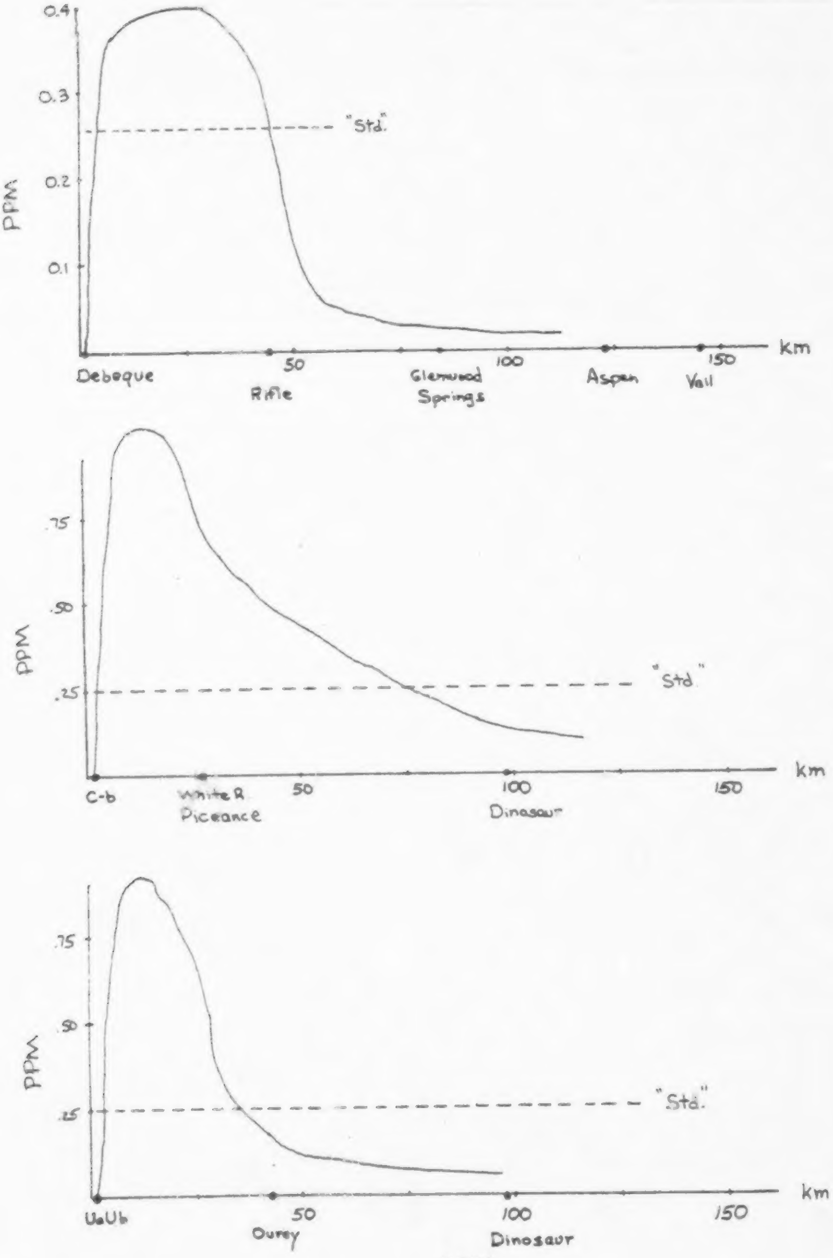


FIGURE 4
PSD AND NAAQS CONCENTRATIONS, ug/m3

Figure 5
NO_2


0.4
0.3
0.2
0.1
PPM
"Std."
50
100
150
km
Debeque
Rifle
Glenwood Springs
Aspen
Vail
.75
.50
.25
PPM
"Std."
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150
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C-b
White R
Piceance
Dinosaur
.75
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.25
PPM
"Std."
50
100
150
km
UaUb
Ourey
Dinosaur

CLASS I AREAS

A. DINOSAUR NATIONAL MONUMENT (STATE)
B. MT ZIRKEL WILDERNESS
C. FLAT TOPS WILDERNESS
D. MAROON BELLS-SNOWMASS WILDERNESS
E. WEST ELK WILDERNESS
F. BLACK CANYON OF THE GUNNISON NATIONAL MONUMENT (STATE.)
G. COLORADO NATIONAL MONUMENT (STATE)
H. ARCHES NATIONAL PARK

OIL SHALE SITES

1. C-a
2. C-b
3. COLONY
4. UNION
5. NOSR
6. MOBIL
7. CITIES SERVICE
8. CHEVRON
9. SUPERIOR
10. U-b
11. U-a
12. TOSCO SAND WASH

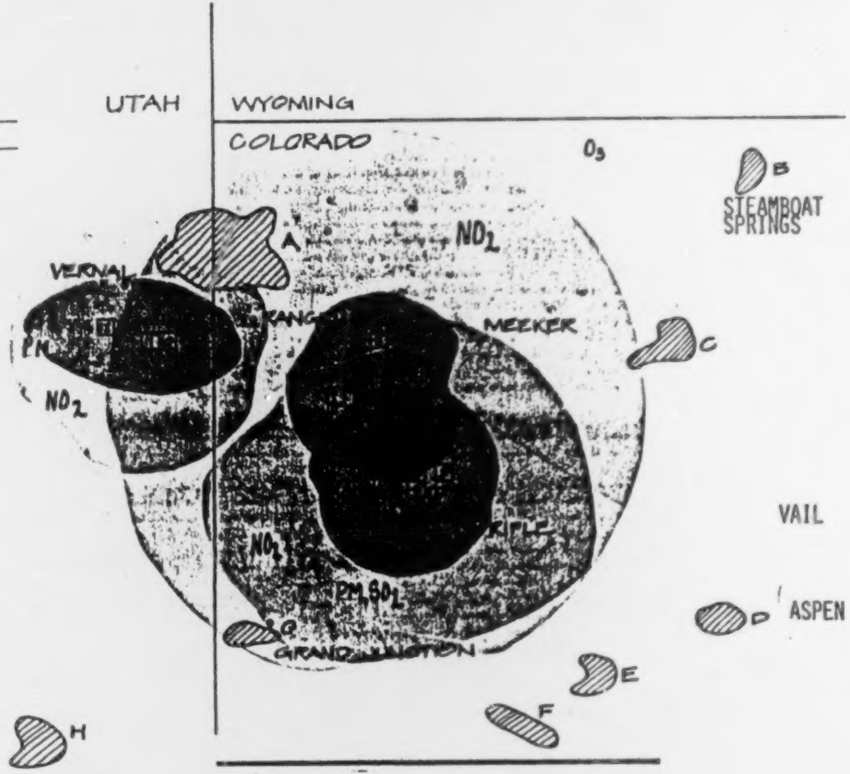
UTAH
WYOMING
COLORADO
O_3
B
STEAMBOAT SPRINGS
A
NO_2
VERNAL
PM
NO_2
RANG
MEEKER
C
VAIL
RIFLE
NO_2
PM, SO_2
D
ASPEN
G
GRAND JUNCTION
E
F
H

FIGURE 1

OIL SHALE STUDY AREA HEALTH STANDARD VIOLATIONS

8 MILLION BPD CASE

CLASS I AREAS

A. DINOSAUR NATIONAL MONUMENT (STATE)
B. MT ZIRKEL WILDERNESS
C. FLAT TOPS WILDERNESS
D. MAROON BELLS-SNOWMASS WILDERNESS
E. WEST ELK WILDERNESS
F. BLACK CANYON OF THE GUNNISON NATIONAL MONUMENT (STATE)
G. COLORADO NATIONAL MONUMENT (STATE)
H. ARCHES NATIONAL PARK

OIL SHALE SITES

1. C-a
2. C-b
3. COLONY
4. UNION
5. NOSR
6. MOBIL
7. CITIES SERVICE
8. CHEVRON
9. SUPERIOR
10. U-b
11. U-a
12. TOSCO SAND WASH

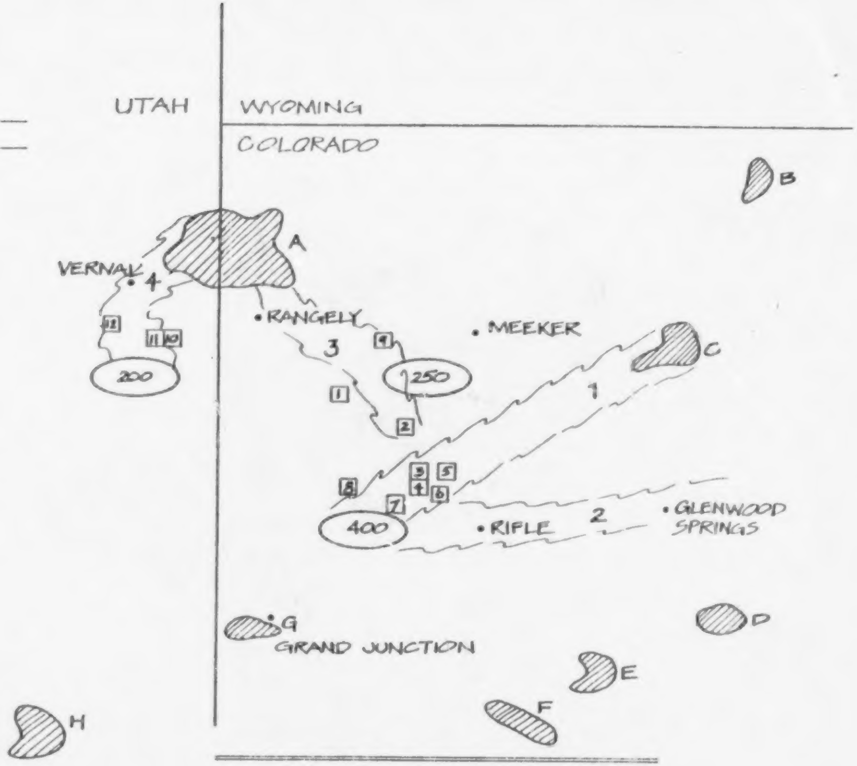
UTAH
WYOMING
COLORADO
B
A
VERNAL
4
RANGELY
MEEKER
C
12
11
10
9
3
200
250
1
1
2
5
5
8
4
6
7
400
RIFLE
2
GLENWOOD SPRINGS
G
GRAND JUNCTION
D
E
F
H

FIGURE 2

OIL SHALE

STUDY AREA-DISPERSION PATTERNS

Figure 3

PREDICTED SHALE OIL PRODUCTION LEVELS FROM WESTERN OIL SHALE RESOURCES
1980 - 1996

(BARRELS PER CALENDAR DAY)

MAR. 1980

	OIL SHALE PROJECTS		1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
①	OCCIDENTAL OIL SHALE LEASE TRACT C-b	a	PILOT OPERATION, ENGR PERMITTING, CONSTRUCTION				6,250	30,000	50,000	65,000	84,600	94,050	100,000	COMMERCIAL OPERATION					
②	PROJECT RIO BLANCO LEASE TRACT C-a	b	PILOT OPERATION, ENGR PERMITTING, CONSTRUCTION				19,000	45,600	76,000	COMMERCIAL OPERATION ENGR, PERMITTING, CONSTRUCTION					90,800	111,600	135,000	COMMERCIAL OPERATION	
③	GEOKINETICS, INC UINTA BASIN	c	SAME AS ABOVE		5,000	5,000	10,000	15,000	25,000	40,000	50,000								
④	EQUITY OIL PICEANCE BASIN	d	PILOT OPERATION		PLANS DEPEND UPON OUTCOME OF PILOT OPERATIONS														
⑤	NAVAL OIL SHALE RESERVE PICEANCE BASIN	e	FEASIBILITY STUDY				DESIGN PERMITTING		CONSTRUCTION				28,000	41,500	50,000	COMMERCIAL OPERATION			
⑥	DEMONSTRATION OF ABOVE GROUND RETORTING (DOE - PON)	f	MODULE DESIGN	MODULAR PLANT CONSTRUCTION		9,000	4,000	END PROJECT											
⑦	DEMONSTRATION OF ADVANCED RETORT TECHNOLOGY (DOE PON)	g	RESEARCH				PILOT TESTS, ENGINEERING, PERMITTING MODULE CONSTRUCTION						8,000	8,000	END PROJECT				
⑧	UNION OIL LONG RIDGE, PICEANCE BASIN	h	CONSTRUCTION		9,500	MODULE OPER CONSTRUCTION		30,000	50,000	COMMERCIAL OPERATION SCALE UP							75,000	100,000	
⑨	COLONY/TOSCO PARACHUTE CREEK, PICEANCE BASIN	i	DESIGN, CONSTRUCTION				25,900	38,400	46,200	COMMERCIAL OPERATION									
⑩	TOSCO SAND WASH UINTA BASIN	j			PERMITTING CONSTRUCTION			23,100	46,200										
⑪	WHITE RIVER PROJECT LEASE TRACTS Ua,Ub, UINTA BASIN	k	EXACT SCHEDULE WILL DEPEND UPON OUTCOME OF LITIGATION													45,000	90,000		
⑫	CHEVRON OIL PICEANCE BASIN	l	ENGR, PERMITTING, PILOT MODULE CONSTRUCTION				7,000	15,600	24,200	32,800	41,400	50,000	66,600	83,200	100,000				
⑬	SUPERIOR OIL PICEANCE BASIN	m	PERMITTING, CONSTRUCTION					6,700	10,000	12,000	COMMERCIAL OPERATION								
⑭	MOBIL OIL PICEANCE BASIN	n	ENGINEERING, PERMITTING, CONSTRUCTION						6,000	6,000	30,600	42,500	50,000	COMM OPERATION SCALE UP			78,000	91,500	100,000
⑮	EXXON	o	ENGINEERING, PERMITTING, CONSTRUCTION						16,800	24,900	30,000	45,000	60,000	COMMERCIAL OPERATION					
⑯	CITIES SERVICES PICEANCE BASIN		NO DEFINITE PLANS AT THIS TIME																
	TOTAL PROJECTS		0	0	14,500	22,500	81,650	204400	350400	399,100	467,000	511,950	593,600	623,100	655,200	721,000	842,400	[illegible]	887,400

FIGURE 6

O_3

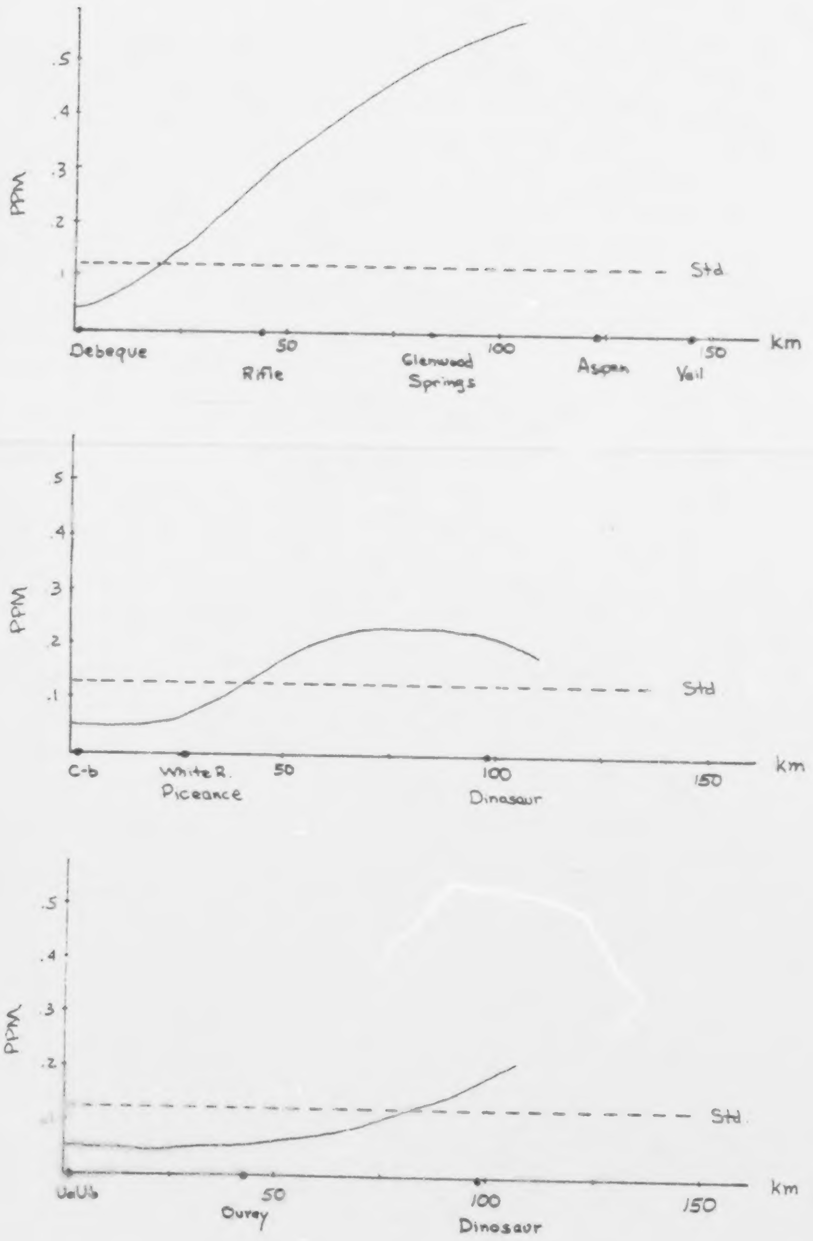
PPM
.5
.4
.3
.2
.1
Std
50
100
150
km
Debeque
Rifle
Glenwood Springs
Aspen
Vail
PPM
.5
.4
.3
.2
.1
Std
C-b
White R. Piceance
50
100
150
km
Dinosaur
PPM
.5
.4
.3
.2
.1
Std
UaUb
50
Ourey
100
Dinosaur
150
km

FIGURE 7
SO_2

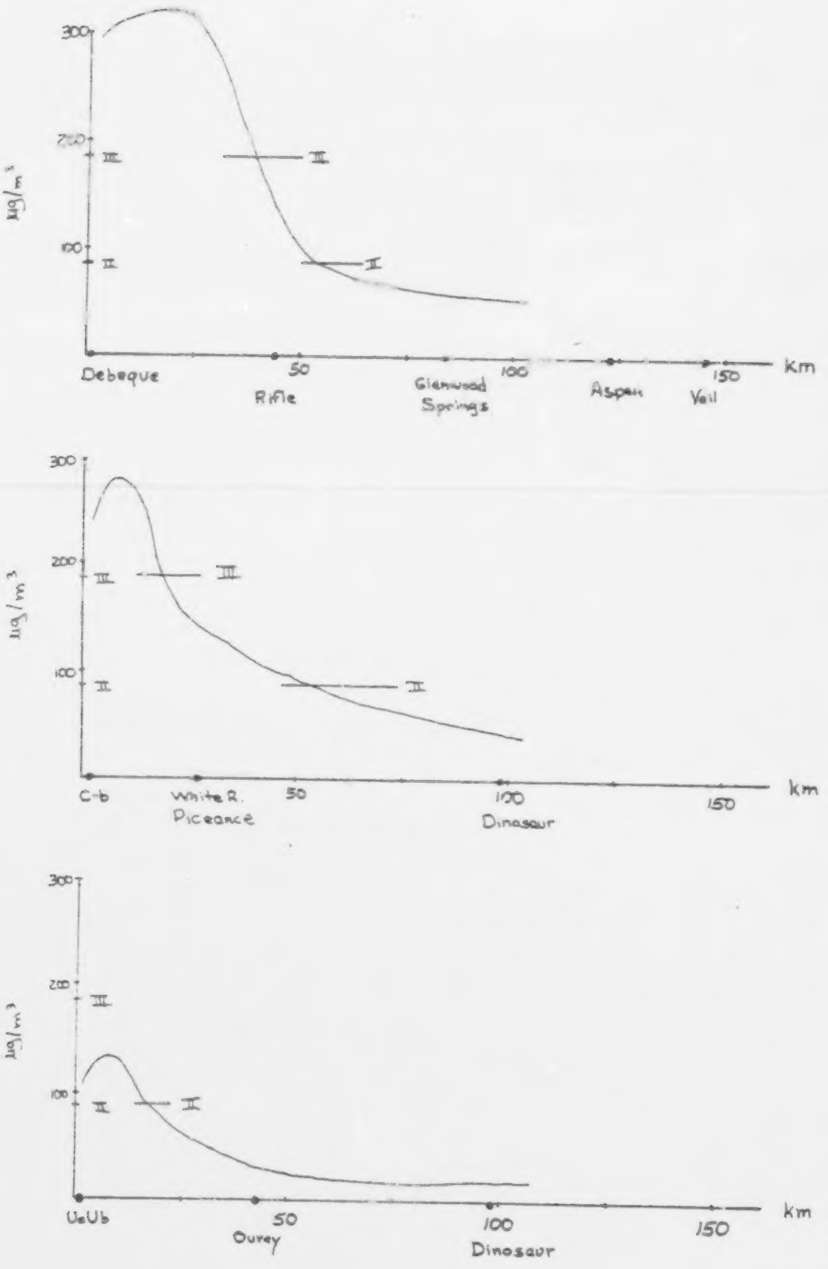
300
200
100
III
II
µg/m³
Debeque
50
Rifle
Glenwood Springs
100
Aspen
150
Vail
km
C-b
White R.
Piceance
Dinosaur
U-Ub
Ourey

FIGURE 8
PM

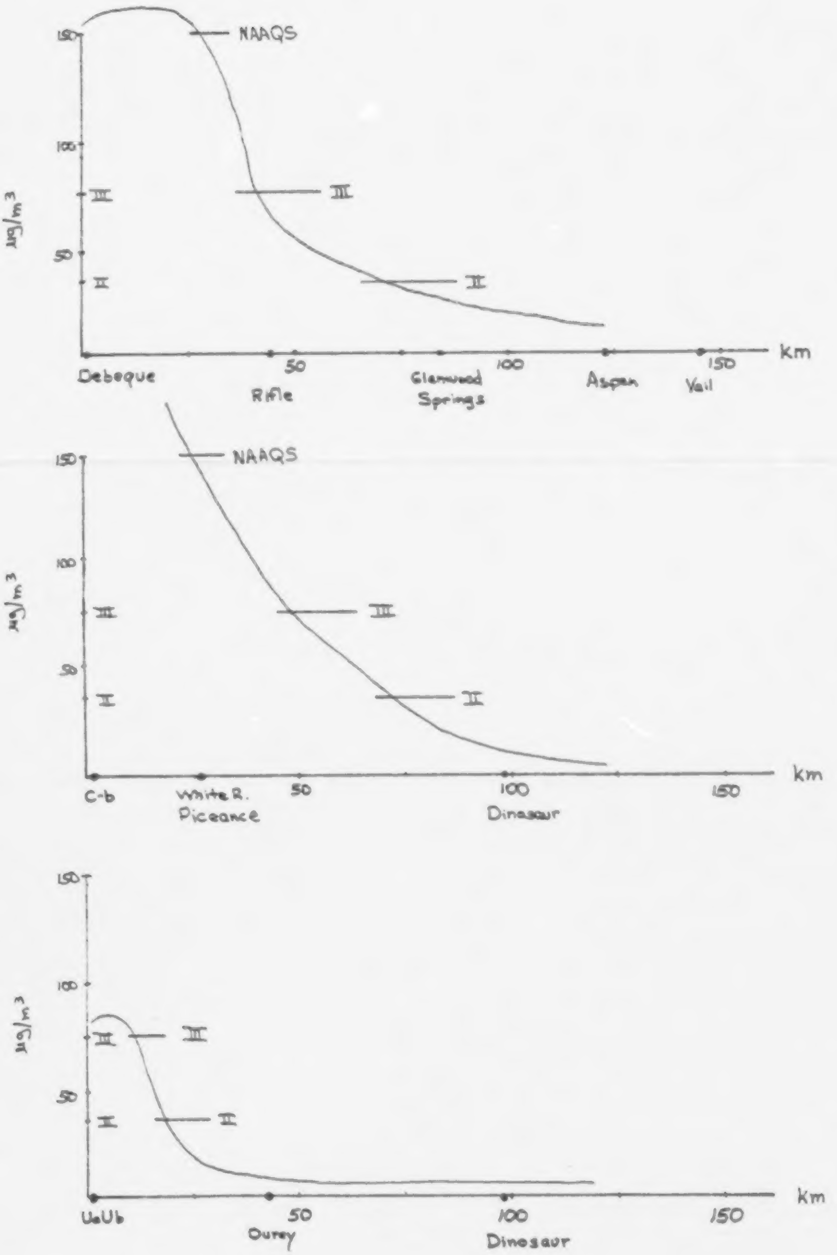
150
100
50
μg/m³
III
II
NAAQS
III
II
km
50
100
150
Debeque
Rifle
Glenwood Springs
Aspen
Vail
150
100
50
μg/m³
NAAQS
III
II
III
II
km
50
100
150
C-b
White R. Piceance
Dinosaur
150
100
50
μg/m³
III
II
III
II
km
50
100
150
UaUb
Ourey
Dinosaur

TABLE 1
AIR QUALITY IMPACTS
BPD CONSTRAINT AND EXTENT OF VIOLATIONS

BASIN

			S. Piceance	N. Piceance	Uintah	TOTAL
O_3	1)	Violations occur at	450	400	260	1110 K BPD
		distance	90 km +	100 km +	100 km +	
	2)	8 million BPD violations			"everywhere"	
NO_2	3)	Violations occur at	2000	1100	400	3500 K BPD
		distance	to 15 km	to 10 km	to 10 km	
		8 million BPD violations	to 30 km	to 75 km	to 35 km	
SO_2	5)	8 million BPD NAAQS violations				
		distance	to 20 km	none	none	
	6)	Class II	to 30 km	to 15 km	none	
	7)	Class III	to 25 km	to 10 km	none	
	8)	Class I constraint	1000	750	1200	2950 K BPD
PM	9)	8 million NAAQS violations				
		distance	to 15 km	to 10 km	to 10 km	
	10)	Class II	to 25 km	to 50 km	to 30 km	
	11)	Class III	to 20 km	to 20 km	to 15 km	
	12)	Class I constraint	4000	1400	3300	8700 K BPD

Table 3

8 million BPD Case

I. NO_2 Concentrations - 1 hour

A. S. Piceance 3 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.39	.38	.09	.03

B. N. Piceance 4 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.896	.58	.38	.16

C. Uintah 1 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.875	.43	.25	.03

II. Ozone Concentrations - 1 hour

A. S. Piceance 3 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.045	.127	.30	.55

B. N. Piceance 4 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.05	.05	.192	.176

C. Uintah 1 million BPD

Distance, km	10	25	50	100
Concentration, ppm	.04	.05	.05	.26

III. SO_2 Concentrations - 24 hour

A. S. Piceance 3 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	292	316	84	64

B. N. Piceance 4 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	256	136	90	58

Table 3 (continued)

C. Uintah 1 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	134	60	36	22

IV. PM Concentrations - 24 hour

A. S. Piceance 3 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	164	140	40	15

B. N. Piceance 4 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	384	180	70	14

C. Uintah 1 million BPD

Distance, km	10	25	50	100
Concentration, $\mu g/m^3$	84	22	12	5

Table 4

Implied Constraints

I. NO_2

S. Piceance	1.9 million
N. Piceance	1.1
Uintah	0.3
Total	3.3 million BPD

II. O_3

S. Piceance	.7
N. Piceance	2.5
Uintah	.5
Total	3.7

III. SO_2	Class II	Class III
S. Piceance	0.9	1.8
N. Piceance	1.4	2.8
Uintah	0.7	1.4
Total	3.0	6.0

IV. PM	Class II	Class III
S. Piceance	0.7	1.4
N. Piceance	0.4	0.8
Uintah	0.4	0.8
Total	1.5	3.0

Senator HART. Mr. Markey?

STATEMENT OF KEVIN L. MARKEY, FRIENDS OF THE EARTH

Mr. MARKEY. Friends of the Earth appreciates the opportunity to testify today to the Senate Budget Committee and to members of the panel here concerning air quality and the long-term future of the oil shale industry.

We are disturbed but not surprised by Exxon's single-minded pursuit of synthetic fuels at the expense of Colorado and the West. I'm glad that Exxon though recognizes that additional public planning and analysis is necessary. This is a point that should be of extreme interest to the Budget Committee.

We must recognize that Exxon's energy planning is approached from its own narrow point of view. It includes energy supply and demand variables, but it also considers profitability and the appropriateness of the investments which Exxon is best able to make. Exxon's investment portfolio is actually much more limited than the public's. An investment in energy conservation, for example, requires the effort of the producer of the end-use device and the energy consumer. Thus, the energy debate needs to be broadened by a public discussion of energy; that is, investment alternatives.

Unfortunately, the Federal Government is ill-equipped today to foster such a debate which requires an ongoing analytic effort. There are no publicly accountable mechanisms available to project our national energy requirements by end-use sector, to compare the environmental, social, and economic consequences of energy technologies and energy systems on an objective and equitable basis, or to evaluate alternative energy futures. We have been forced to be satisfied with piecemeal, though valiant, private efforts.

Exxon's emphasis on synthetic fuels results from its narrow vision. With the proper tools, our vision can be much broader. Otherwise, we will come to depend on the only alternatives which come before us and will be faced with "Colorado laid waste," as the Energy Daily put it, by a massive industry. We are convinced that a broader vision will see more opportunities for liquid fuels conservation and an earlier contribution from renewable sources.

I'm somewhat more pessimistic than even Terry Thoem is here. Rather than reinventing the wheel, in response to the questions that the committee have sent me, I'm going to start where Exxon and EPA have left off.

AIR EMISSIONS—A DISAPPEARING ACT?

It has become clear, for example, in several presentations by Exxon that it believes air emission rates will decline over the life of the industry, making possible production rates of unbelievable size without violating clean air standards.

Several technical uncertainties persist regarding the effectiveness of sulfur dioxide control, for example. Indeed, no shale oil facility has ever been operated with sulfur removal equipment of commercial design at whatever scale. Control technologies have been borrowed from other industries.

These borrowed technologies may not be entirely applicable to shale oil processing emissions. For example, high off-gas rates may reduce the effectiveness of controls and different constituents may be present in off-gas streams. Both problems plague Occidental oil shale modified in situ process, for example.

Similarly, the controls which are planned for oil shale applications may not be effective after scale-up to commercial scale.

EPA and industry estimates do not consider the effect of upset conditions in retorting or refining. The most serious pollution incident in the history of oil shale pilot plant experimentation was the serious out-of-control modified in situ retort at Oxy's Logan Wash.

Related to upset conditions is retort process control. Reduced resource recovery associated with poor process control in MIS will increase the sulfur emitted per barrel of shale oil produced.

EPA's emission densities only count the contribution of shale retorting and partial upgrading. They are based on the maximum emission rate for the Colony plant. They do not include sulfur dioxide sources elsewhere in northwestern Colorado and the Uinta Basin.

The associated growth usually attributed to oil shale is limited to residential communities, usually low sulfur-emitting sources. If, however, we begin to approach Exxon's scenario or even 1 or 2 million barrels per day, other factors enter the pollution inventory picture: On- or near-site upgrading; on- or near-site full refining; associated electric power generation; associated industrial development such as aluminum manufacture to take advantage of supply of dowsonite available in this region within the oil shale itself, industrial fabrication stimulted by the demands of a large oil shale industry; independent regional energy developments: coal, synfuels, and others; and the degree of cogeneration in the oil shale industry.

Pollutants other than sulfur dioxide may be more difficult to control. Some, such as particulate control, may have reached, limits of control effectiveness. Others, such as NO_x, trace organics, and trace metals, so important to public health, may just resist solutions. We are hopeful that more effective means are found, but Exxon and we cannot rely blindly on that possibility.

AIR QUALITY MODELING

Ambient air quality modeling is a major unresolved issue. Existing models of air dispersion simplify actual atmospheric conditions.

For quite some time now, scientists, regulators, and the industry have sought a more satisfactory model which actually characterizes air movements in areas of complex terrain such as the Piceance Basin.

One EPA estimate of limits on the growth of the shale industry, 400-000-barrels-per-day. Other estimates are based on less conservative models.

However, even these simple models may be too liberal under certain circumstances, underestimating actual ambient air effects. For example, the basin is characterized by long-lasting inversions and a diurnal air flow which may trap pollutants in the region for days, sloshing back and forth until the affected air mass moves. The transport of a large mass of polluted air, evident in many highly polluted urban areas, may have effects not considered by even a complex terrain model but which will affect all Colorado, including distant park areas.

Exxon claims, in response to questions at its meeting this past Monday, that whereas high pollution levels requiring changes in standards may be achieved in the basin, violations of class I increments will not occur. This does not coincide with reality.

ROSE COLORED POLITICS

If it is difficult to accept Exxon's optimistic technical analysis of emissions, it is even less likely that we can accept its rose-tinted view of air quality regulation and politics, especially given our experience. Even if Exxon is willing to spend the sums necessary to control emissions to low levels, other members of the industry may not be so willing.

There is a long history of industry attempts to avoid compliance with the law or to weaken the standards. After Colorado initially promulgated strict ambient air quality standards for most of the State, the industry fought for a long time and finally won concessions to weaken them and allow a moderately sized industry.

In 1979, also the industry and others were instrumental in passage of Colorado House bill 1109 which, again, met ambient air standards. Currently, Occidental is trying to handicap Colorado's emission rate standard for sulfur dioxide. If Oxy is successful, it may succeed in monopolizing the Class I increment in Flattops. This may force earlier revision of the Clean Air Act. It also penalizes developers who have chosen to expand their production more gradually to be able to improve controls in a timely manner.

Despite the ability to proceed to a moderate 400,000-barrel-per-day industry without changes to the Clean Air Act, the shale industry already has targeted the law for wholesale destruction. This gives us little comfort in Exxon's polite assurances.

What will be the effects of a 2-million-barrel-per-day industry in oil shale's air, which is about one-quarter of Exxon's plant, we can't say for sure. But, conservatively, we do know the violations of ambient air quality standards and visibility protection provisions will occur in the basin itself and the recreation areas such as wilderness and parks unless emission rates are reduced to a fraction of the projected levels, we think that the associated industrial development will locate in the valley areas and acerbate the concern there. We would be very cautious about proceeding with development beyond 400-000-barrels-per-day. Given the uncertainties in modeling and emission rates, its' best to act conservatively.

AIR QUALITY POLICIES TO AVOID AND TO PROMOTE

It is clear today that liquid fuel supplies are insecure. It's also evident that the price of foreign crude has made shale oil competitive. However, no synthetic fuel is going to solve our energy supply-demand conflict overnight.

Lead times limit our responsiveness to a serious problem. Given these confines, there is no reason to push shale faster than it can proceed anyway. Our own approach has shifted to accept the reality

TABLE 2

(1.) From City-County Data Book
(2.) From 1975 National Emissions Report

EMISSIONS DENSITY COMPARISONS

Region	Square Miles(1)	Particulate Matter(2) T/YR	Particulate Matter(2) T/YR/MI^2	Nitrogen Oxides(2) T/YR	Nitrogen Oxides(2) T/YR/MI^2	Sulfur Oxides(2) T/YR	Sulfur Oxides(2) T/YR/MI^2
Oil Shale	2,500	160,000	64	1,100,000	440	200,000	80
NY-NJ-Conn.	5,019	191,170	38	878,782	175	361,219	72
NJ Intrastate	1,978	16,395	8	46,289	23	47,597	24
Philadelphia	4,146	165,251	40	391,146	94	456,536	110
S. Delaware	1,544	6,793	4	25,122	16	49,481	32
Baltimore	2,256	69,872	31	159,332	71	124,216	55
E. Shore, MD	3,393	3,989	1	23,960	7	9,842	3
S. Maryland	1,049	8,265	8	29,653	28	63,547	61
D.C.	2,326	62,945	27	190,196	82	203,124	87
Total Coastline NY-DC	21,711	524,680	24	1,744,480	80	1,315,562	61
Houston Galv.	11,734	186,309	16	418,367	36	235,060	20
New Jersey State		130,404		504,256		314,987	
Delaware	1983	30,382		72,607		224,718	

EMISSIONS DENSITY COMPARISONS (cont.)

Region	Square Miles(1)	Particulate Matter(2) T/YR	Particulate Matter(2) T/YR/MI^2	Nitrogen Oxides(2) T/YR	Nitrogen Oxides(2) T/YR/MI^2	Sulfur Oxides(2) T/YR	Sulfur Oxides(2) T/YR/MI^2
Colorado	103,797	57,610		241,725		117,135	
Denver AQCR	4,203	15,589	4	119,202	28	41,886	10
California	156,537	557,612		1,451,248		494,856	
Maryland	9,888	131,396		319,351		353,460	
Pennsylvania	45,026	722,312		1,039,418		2,134,470	
Massachusetts	7,833	95,966		397,183		304,621	
Utah	82,381	104,175		124,651		188,099	
Wasatch AQCR	3,656	81,137	22	83,180	23	165,326	45

of a pioneer industry and work to minimize its effects. I would emphasize, though, that we have not accepted a permanent commitment to a large industry.

Given the need to minimize our risks, there are a number of policies to avoid regarding air quality protection. One of them is to resist amendment of the Clean Air Act.

We must also demand strict enforcement of existing law and filling in the holes where new regulation is needed. Public involvement in this effort is necessary and productive. I call attention to the Colony Development Operation that has just announced a 30-percent reduction in its projected sulfur dioxide emissions in compliance with a condition of approval of its EPA PSD permit which resulted from Friends of the Earth's comments on that application. R. & D. needs are also important.

Finally, closely related to better scrutinizing the future is the absolute necessity of maintaining the opportunity, after adequate experience with a pioneer industry, to make an informed decision about the future of oil shale. How large an industry can we accommodated? How must we design effective protections? Is the effort even worthwhile?

Oil shale leasing policy can help create a discrete decision point before we eliminate future options. Also, not changing the Clean Air Act will keep a pioneer industry to a manageable and reasonable size before we irreversibly commit this region to a future which it may decide later is not acceptable. We are not speaking of stopping or preventing the development of any industry. That is clearly not possible today following adoption of subsidies and changes in oil supply and economics. However, outlining how a phased development approach will be able to work practically is important.

Unfortunately, the Department of the Interior has created what we feel is an unacceptable leasing program. There are some positive features about it. However, the design of a permanent program will be complete in 2 years, much before we have any experience with commercial facilities. The Department proposed legislation, including the authorization of multiple lease tract ownership and increasing the size of lease tracts, which we believe will allow Exxon vision to occur. The size of the prototype program will double, but the problems which resulted in its partial failure—the testing of only one technology—have not been solved or addressed. Worst of all, in the initial planning of the program, the Department has refused to recognize legitimate local government needs for tools in the leasing program to mitigate socioeconomic impacts and refuses to make local government an equal partner in the planning process.

We are pleased that you rejected the amendments to the Mineral Leasing Act which would allow the larger, multiple tract ownership. However, we are disturbed that the Department blames you almost exclusively for the vigor with which they have pursued their program. We still hope that you might bring some moderation to their overenthusiasm. Thank you.

PREPARED STATEMENT OF KEVIN L. MARKEY, FRIENDS OF THE EARTH

Friends of the Earth appreciates the opportunity to testify today to the Senate Budget Committee concerning air quality and the long term future of the oil shale industry. We are disturbed but not surprised by Exxon's single minded pursuit of synthetic fuels at the expense of Colorado and the West. This committee deserves our appreciation for investigating Exxon's proposals in more detail.

Air quality is but one problem associated with oil shale development. Water consumption, water quality, community growth, solid waste disposal and wildlife pose other risks of the industry. In response to the Committee's request, we will start by addressing the likely impacts on air quality, but conclude by addressing broader public policy questions which will affect air quality concerns and the others.

Air Emissions -- A Disappearing Act?

It has become clear in several presentations by Exxon that they believe air emission rates will decline over the life of the industry, making possible production rates of unbelievable size without violating clean air standards. We cannot accept this magic. Air pollution controls may improve, but they may not improve to the extent necessary to accomodate a large industry without wholesale destruction of the Clean Air Act.

Several technical uncertainties persist regarding the effectiveness of sulfur dioxide control, for example. Indeed, no shale oil facility has ever been operated with sulfur removal equipment of commercial design, at whatever scale. Control technologies have been borrowed from other industries.

* These borrowed technologies may not be entirely applicable to shale oil processing emissions. High off-gas rates may reduce the effectiveness of controls. This is one problem which has arisen with Occidental's modified in situ technology. Another difficulty may be the constituents present in off-gas streams. This plagues MIS retorting as well. Oxy claims that the large concentration of CS_2 and COS in the off-gas will substantially reduce the effectiveness of the proposed Stretford control units. It may be possible to chemically convert these contaminants to a gas which may be treated and removed. However, Occidental claims that it will be costly. We are not so sure. The point, however, is that emissions may not be able to be reduced as much as Exxon would like. (1)

* Similarly, the controls which are planned for oil shale applications may not be effective after scale up to commercial scale. Most have been used for small scale operations.

* The concentration of inorganic sulfur in oil shale is somewhat variable. Retorting of shale with high inorganic S in an oxidizing environment will significantly increase the level of sulfur compounds in off-gas.

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(1) EPA's estimates presented at the previous hearing are based on a 0.16 lb/barrel emission rate. MIS emissions are 0.58 lb/barrel

- EPA and industry estimates do not consider the effect of upset conditions in retorting or refining. The highest emissions which characterize refining, for example, are due to poor maintenance or poorly operating units. The most serious pollution incident in the history of oil shale pilot plant experimentation was the serious out-of-control modified in situ retort at Oxy's Logan Wash. It emitted not just off-gasses, but shale oil mists, combustion products, and retort waters.

- Related to upset conditions is the status of retort process control itself. Most scientific and regulatory concern has focused on modified in situ, which has thus far resisted reliable process control. Oxy has seen, in effect, three straight failures. Reduced resource recovery associated with poor process control in MIS will increase the S emitted per barrel of shale oil produced.

EPA's emission densities only count the contribution of shale retorting and partial upgrading. They are based on the maximum estimated emission rate for the Colony plant. (0.16 #/bbl). They do not include sulfur dioxide sources elsewhere in northwestern Colorado and the Uinta Basin. Even most so-called "cumulative" air pollution assessments which are available to EPA to determine the combined effect of the shale industry and associated growth do not include the potential for large S emissions from industrial growth. The "associated growth" usually attributed to oil shale is limited to residential communities. If, however, we begin to approach Exxon's senario, or even one or two million barrels per day, other factors enter the pollution inventory picture:

- On- or near-site upgrading. EPA's 0.16#/B emission rate assumes hydrotreating, but Oxy's 0.41 to 0.58#/B only includes blending and the addition of pour point depressants. Hydrotreating on-site would increase this number.

- On- or near-site full refining. Hydrotreating only prepares the shale oil for conventional refining.

- Associated electric power generation.

- Associated industrial development. E.g., Aluminum manufacture (due to large supply of dawsonite, an aluminum ore); industrial fabrication (stimulated by a large oil shale industry's needs).

- Independent regional energy developments: coal, synfuels, other.

- The degree of cogeneration in the oil shale industry.

Pollutants other than sulfur dioxide may be more difficult to control. Some, such as particulate control, may reach limits of control effectiveness. Others, such as NOx, trace organics and trace metals may just resist solutions. About the only NOx control which has emerged from the past several years of discussions is control of combustion conditions. We are hopeful that more effective means are found, but Exxon cannot rely blindly on that possibility. The hazards of trace metals (such as mercury and arsenic) and organics should not be ignored. The difficulty of removing these constituents results from their very small concentrations in very large gas streams. Health of workers and area residents should not be sacrificed.

Ambient air quality modeling is a major unresolved issue. Existing models of air dispersion simplify actual atmospheric conditions. The model used in the oil shale region now, the EPA Valley Model, does not correspond to actual situation. It assumes that a plume of contaminated air will rise to a certain height and then be mixed and diluted with surrounding air until it impacts the ground surface. The stability of the subject air mass affects the rate of dilution and mixing.

For quite some time now, scientists, regulators, and the industry have sought a more satisfactory model which actually characterizes air movements in areas of rough terrain such as the Piceance and Uinta basins. That environment is affected by a variety of atmospheric phenomena.

One EPA estimate of the Clean Air Act's limits on the growth of the shale industry -- 400,000 BPD -- is based on the Valley Model and limits of the Flattops Wilderness Area. Another estimate, presented at the last hearing is based on a simple box model. The Valley Model was more conservative, because it did not account for the siting of facilities. The box model is over simplified, but makes up one component of a complex terrain model. At least it accounts for directional air flow and siting of facilities.

However, even these simple models may be too liberal under certain circumstances, underestimating actual ambient air effects. For example, the Piceance Basin is noted for its frequent inversions. Under one set of conditions, pollutants stay trapped near the inversion level, then undergo mixing which may carry them to the surface when the inversion is broken by heating. This fumigation model describes the situation caused by a large Canadian smelter which has been the subject of considerable international irritation. The surface fumigation, however, may only last a short period of time. Thus, it may not result in a violation, although it may cause repeated exposures to high levels of pollutants.

The basin is also characterized by long-lasting inversions and a diurnal air flow which may trap pollutants in the region for days, sloshing back and forth until the affected air mass moves. The transport of a large mass of polluted air--evident in many highly polluted urban areas--may have effects not considered by even a complex terrain model, but which will affect all Colorado, including distant park areas.

Exxon claims, in response to questions at its meeting this past Monday, that whereas high pollution levels requiring changes in standards may be achieved in the Basin, violations of Class I increments will not occur. This does not coincide with reality. The levels of development in the Basin anticipated by the largest unregulated corporation, by any stretch of the imagination, cannot fit under Class I increments.

We cannot respond to the Committee's question about what the air quality impacts of a multi-million barrel per day industry would be quantitatively. The only analysis which we have seen are those performed by EPA. The Valley Model estimate of 400,000 BPD limits is probably conservative. However, the box model which allows a larger industry is probably liberal. The legal Class I limits probably lie somewhere in between. We would be very cautious about proceeding with development beyond 400,000 BPD. An industry of 2,000,000 BPD would likely bring about perceptible air quality changes in the region -- both in the parks and in the relatively small urban areas which will grow larger and dirtier with the industry. Visibility will substantially decline. We believe that trace organics may spread the characteristic odor of the industry as well.

Given the uncertainties in modeling and emission rates, it is best to act conservatively.

Rose Colored Politics

If it is difficult to accept Exxon's optimistic technical analysis of emissions, is is even less likely that we can accept rose-tinted view of air quality regulation and politics, especially given our experience. Even if Exxon is willing to spend the sums necessary to control emissions to low levels, other members of the industry are not.

There is a long history of industry attempts to avoid compliance with the law or to weaken the standards. After Colorado initially promulgated strict ambient air quality standards for most of the State, the industry fought for a long time, and finally won concessions to weaken them and allow a moderately sized industry. In 1979, the industry and others were instrumental in passage of Colorado House Bill 1109. This Act prohibits the State from setting standards more strict then the federal limits. In effect, Colorado's ambient standards were weakened again. Provisions in that law are also said to be designed to allow multi-mineral processing facilities to obtain even feebler regulation, despite the production of nahcolite, an anti-pollution agent,by that process. Currently Occidental is trying to handicap Colorado's emission rate standard for sulfur dioxide--the only technology forcing regulation applicable to oil shale processing. If Oxy is successful, it may succeed in monopolizing the Class I increment in Flattops. This may force earlier revision of the Clean Air Act. It also penalizes developers who have chosen to expand their production more gradually to be able to improve controls in a timely manner.

Despite the ability to proceed to a moderate 400,000 BPD industry without changes to the Clean Air Act, the shale industry already has targeted the law for wholesale destruction. This gives us little comfort in Exxon's polite assurances.

If the industry succeeds in improving sulfur or other pollutant control efficiency during the initial generations, it might be technically possible to retrofit those first generation plants. Otherwise, they will retain their poor efficiencies. Without retrofitting these early facilities, it will be difficult to reach large production levels without challenging standards again. The attitude of most of the industry gives us dim expectations. No one argued more vigorously for the grandfather clause in the Energy Mobilization Board legislation than the synfuels proponents.

Air Quality Policies to Avoid and to Promote

No one understands the politics and economics of our new energy situation better than the environmental community. Indeed, we have tried for several years to obtain a commitment to develop less risky energy alternatives before a crisis forced us into the arms of Exxon. It is clear that liquid fuel supplies are insecure. It is also evident that the price of foreign crude has made shale oil competitive. However, no synthetic fuel is going to solve our energy supply/demand conflict overnight. The Senate Budget Committee's synthetic fuels report makes clear the limits and costs of expanding the industry too fast. So does the recent report of the Office of Technology Assessment. Lead times limit our responsiveness to a serious problem. Given these confines, there is no reason to push shale faster than it can proceed anyway. Also, our own approach has shifted to accept the reality of a pioneer industry and work to minimize its effects. I would emphasize, though, that we have not accepted a permanent commitment to a large industry. More on that below.

Given the need to minimize our risks, there are a number of policies to avoid regarding air quality protection. Air sheds, such as Flattops and other class I areas should not be redesignated. Neither should the Class I ambient standard be changed. Emission standards should be maintained or even strengthened. To maximize shale oil production without threatening ambient air quality, the EPA has established a policy to encourage better than BACT controls. We support that and believe it deserves embodiment in law. We cannot afford to lose the technology-forcing Colorado pounds per barrel standards. Neither can we allow a single operation to monopolize an air increment with large facilities which have inefficient controls.

An opposite approach is needed, demanding strict enforcement of existing law and filling in the holes where new regulation is needed. Public involvement in this effort is necessary and productive. Colony Development Operation has just announced a 30% reduction in its projected sulfur dioxide emissions, in compliance with a condition of approval of its EPA PSD permit which resulted from FOE's comments on the application.

R&D needs to develop less polluting second and third generation technologies, as well as more effective pollution controls. Pioneer and prototype facilities need to be closely monitored for control effectiveness and reliability, ambient air impacts and visibility effects. An accurate air dispersion model must be developed and tested.

Perhaps only two changes might be considered for the Clean Air Act. A technology-forcing emission standard might be considered to encourage the reduction of emission rates over time. Also, the allocation of ambient air increments on a first-in-time, first-in-right basis is perhaps unfair, encourages hogging of the increment, as well as banking of the increment. Alternatives to this may be considered.

Energy Planning Policies

We must recognize that Exxon's energy planning is approached from its own narrow point of view. That includes energy supply and demand variables, but it also considers profitability and the appropriateness of the investments which Exxon is best able to make. Exxon's investment portfolio is actually much more limited than the public's. An investment in energy conservation requires the effort of the producer of the end-use device and the energy consumer. For example, Exxon cannot (or would not ordinarily) invest in a program of more energy-efficient automobiles. General Motors and the auto-driving public might. Exxon's only impact here would be as an energy consumer. Its impact would only be a small fraction of the public's. Thus, the energy debate needs to be broadened by a public discussion of energy, that is, investment, alternatives.

Unfortunately, the federal government is ill-equipped to foster such a debate, which requires an ongoing analytic effort. For several years, FOE has complained in various proceedings overseeing our energy planning that there are no publicly accountable mechanisms to project national energy requirements by end-use sector, to compare the environmental, social and economic consequences of energy technologies and energy systems on an objective and equitable basis, or to evaluate alternative energy futures. We have been forced to be satisfied with piecemeal (though valiant) private efforts. Recently, the Congress directed the Department of Energy to start undertaking the effort of energy forecasting and planning in the Energy Security Act. Few criteria and little guidance was provided in the legislation, and there was no requirement that the process be publicly accountable.

Exxon's emphasis on synthetic fuels results from its narrow vision. With the proper tools, our vision can be much broader. Otherwise, we will come to depend on the only alternatives which come before us, and we will be faced with Colorado "laid waste" by a massive industry. We are convinced that a broader vision will see more opportunities for liquid fuels conservation and an earlier contribution from renewable sources.

Closely related to better scrutinizing the future is the absolute necessity of maintaining the opportunity, after adequate experience with a pioneer industry, to make an informed decision about the future of oil shale. How large an industry can we accomodate? How must we design effective protections? Is the effort even worthwhile? Oil shale leasing policy can help create a discrete decision point before we eliminate future options. Also, not changing the Clean Air Act will keep a pioneer industry to a manageable and responsible size before we irreversibly commit this region to a future which it may decide later is unacceptable. We are not speaking of stopping or preventing the development of any industry. That is clearly not possible today following adoption of subsidies and changes in oil supply and economics. We are, however, outlining how a phased development approach will be able to work practically. Legislation adopted in this Congress eliminates the possibility of limiting the initial oil shale effort to what some analysts still see as a real option--a series of small modular facilities. Private ownership patterns, the interpretation of oil shale leases, and the repeal of the Ottinger module provision in the Non-nuclear Energy Research and Development Act, also the form of approved subsidies prevent restricting the scale of first generation plants. Practical economics, equitable administration of subsidy legislation and sensitive leasing policy can, however, limit the scale of the initial generation. Unfortunately, the leasing initiatives of the Department of the Interior and the prospective rewriting of the Clean Air Act will loosen the cork.

Leasing policy deserves a closer look. Friends of the Earth has supported the possible testing of the multi-mineral processing technology on federal land under the right conditions. We opposed any major expansion of the existing prototype program, believing that the President's and Congress' goal of 400,000 BPD could be easily met by existing leases and private developments. Instead of duplicating several facilities which are planned on private tracts, we suggested that the Department obtain information on those operations (for integration with information obtained by the Prototype Program) through arrangements for the monitoring of non-prototype projects. (2)

FOE also supported an effort to develop resource management strategies to govern and guide any future regional development. These plans would be designed to protect people, air quality, water quality and wildlife. They would be based on what we learn from R&D and pioneer oil shale plants. They would provide guidance to protect us if we had to design and implement a leasing program in response to a crisis. However, they would not result in the premature design of a permanent program which could be abused and used before the need was established by an administration not sensitive to the problems associated with the industry.

Unfortunately, the Department has created what we feel is a monster. The design of a permanent program will be complete in two years, before we have any experience with commercial facilities. The Department proposed legislation--including authorization of multiple lease tract ownership and increasing the size of lease tracts--which will allow the Exxon vision (nightmare?) to occur. The size of the prototype program will double. The problems which resulted in its partial failure--the testing of only one technology--have not been addressed. Worst of all, in the initial planning of the program, the Department refuses to recognize legitimate local government needs for tools in the leasing program to mitigate socio-economic impacts and refuses to make local government an equal partner in the planning process. We are pleased that you rejected the amendments to the Mineral Leasing Act which would allow larger, multiple tract ownership. However, we are disturbed that the Department blames you almost exclusively for the vigor with which they have pursued the new program. We still hope that you might bring some moderation to their over-enthusiasm.

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(2) The legislation you introduced earlier this year on monitoring of oil shale facilities, while it could use improvement, is needed for all pioneer synfuels facilities.

Senator HART. I'm comfounded I have so much power.
Representative Edmonds?

CURRENT VISIBILITY

Representative EDMONDS. Thank you, sir.

Mr. Thoem, I was interested when you mentioned production and visibility for 12 miles. What is it now, the visibility now?

Mr. THOEM. It varies. But some of the monitoring data that has come back, good days are 150, 170 miles.

Representative EDMONDS. On a clear day——

Mr. THOEM. On a clear day you can see forever.

Representative EDMONDS. One of the sheets in your testimony that you didn't discuss, the first staggering statistics—and, indeed, they are—it talks about involved mining were performed via the open pit mining for the 3-million-barrel-a-day scenario, that the equivalent of 80 Bingham Canyon mines would be needed. Now, I was assuming from the Exxon scenario they were talking about six sites on 15,000-acre tracts and the moving pit. They would be reclaiming the pit so you wouldn't have 80 Bingham mines; you'd have six at one time. Is that——

Mr. THOEM. That's a clarification. Mr. Slick mentioned six Bingham-type operations. It could be six operations, but tonnagewise the amount of material that would be moved would be the equivalent of 80 Binghams. If it's envisioned to have six large open pits, you can divide that out. It's six operations 10 to 15 times the size of a Bingham at the present time.

Representative EDMONDS. Then just one final question and that is there seems to be a great discrepancy between some industry's estimates on the air quality impairment and yours. You've mentioned in response to Senator Hart that probably the argument on second generation technology is the basis for that. Is there anything else that would account for that discrepancy?

Mr. THOEM. I think the other areas, the question about modeling, air quality modeling, and its certainty and uncertainty. And that's why I felt like it was important to point out that we can compare emissions and emissions densities with other industrialized urban areas. And we know what those air quality levels are like, so that tends to shed some prospective on modeling results.

Representative EDMONDS. And those comparisons you made in your testimony were for an 8 million barrel a day?

Mr. THOEM. Yes.

Representative EDMONDS. Thank you.

Senator HART. Representative Theos?

HOW TO HANDLE ADVERSE IMPACTS OF OIL SHALE INDUSTRY

Representative THEOS. Thank you, Senator.

You know, this is one time I wish I was last instead of second. But I guess the concerns of all three of you are the concerns of pretty near everybody in Colorado and especially western Colorado. When the ski industry moved into Vail and Aspen and so on, the way of life changed for my colleagues, the sheepmen. They had to move out and give way to you people. Now an industry is coming in, and I think we'll have to have some trade-off. But I don't know.

I guess my question will be to you, Mr. Thoem, what are you going to do? You're either going to have to lower your standards on air quality, or you're going to have to tell these people to shutdown. You've got so many rules and regulations. And I seen a film the other day of what's happening back in New Jersey with the hazardous waste. Maybe you've seen the same thing. It's disastrous. And the one that happened down in Louisiana that killed all those guys' cattle. But you're not doing much about it. You've got the laws and everything, but what are you going to do? Are you going to shut them down and tell them to move out and quit manufacturing and we're going to go back 50 or 60 years, or what are we going to do?

Mr. **Thoem**. To answer your question specifically in relation to oil shale, the process is different, obviously, for oil shale, because we don't have that industry established yet. There's the need to predict what those impacts would be before the industry gets started. So rather than shutting down, you may say you can't build. Then once we say you can't build, then there's that pressure to change standards, change regulations. Again, that will not be our role. That will be the role of Congress. Congress has set up requirements and various pieces of environmental legislation that we carry that out.

A lot of these environmental regulations are not arbitrary bureaucrats like ourselves establishing. We take the direction from the legislation and try and implement that legislation.

Representative **Theos**. Well, both of you worry me.

Senator **Hart**. Senator Soash?

NO ALTERNATIVES TO DEVELOPING SYNTHETIC FUELS INDUSTRY

Senator **Soash**. Thank you, Senator.

Let me say, first of all, as I sat here and listened to the testimony, with all due respect to Mr. Slick, I took his testimony with a grain of salt because I felt it was somewhat biased. And, Mr. Thoem, quite frankly, I take your testimony with the same grain of salt, because I think you're biased in the opposite direction. You know, we're caught in a real dilemma here. On the one hand we've got tremendous need to develop energy resources so we can be energy self-sufficient and that's something not to subscribe to. On the other hand, you say it's impossible to develop that industry.

When the American people in the past have met these kinds of insurmountable problems, we usually came up with the ingenuity and the technology to conquer those problems, almost invariably. And I happen to think that undoubtedly we can in this case. I think it's such a problem that the ramifications of not solving it and such, that we will conquer it. It just seems to me that we ought not to be putting unreasonable roadblocks in the way of developing this.

Let me ask you this: I lived the first 10 years of my life without electricity, without hot water in the house. We went outside to go to the john. I enjoy having these lights on, having this building warm in the winter, cool in the summer, and all the amenities we have. Now, if we don't develop this industry, what's your suggestion? What can we do instead? Can we conserve that much? Obviously not. How do we maximize our energy? How do we solve this problem if we hold this industry at such a low level?

EXAMINE OPTIONS TO DEVELOPING SYNTHETIC FUELS INDUSTRY

Mr. **Markey**. Well, of course, freezing in the dark builds character, but there are other more rational approaches to that, Senator Soash. There really is a dilemma. And I have participated in a couple of studies. For example, I participated in the OTA oil shale assessment and also the oil shale biomass assessment. And there are real dilemmas in terms of what's possible in all the various areas.

I don't think at this point we're talking about creating roadblocks. At this point the roadblocks are starting to come down, at least in terms of an initial industry, a pioneer industry that we can learn from. Congress has decided, for example, that there will be subsidies and there will be some effort to try to get around at least some of the redtape problems. I suspect there will be some sort of energy mobilization board. Hopefully, it won't make mincemeat of local laws and other important legislation. But we don't need to make mincemeat of that legislation initially.

I think initially we can accept as a responsible course seeing what the impacts are of a pioneer industry but at the same time looking at the other options that are before our country. And that's why I began my presentation by pointing out that we need to establish the capability of looking at those options. I perhaps have not observed the oil shale industry as long as a lot of the people in this room, but I have had the opportunity to observe the efforts that have been made in the oil shale and synthetic fuels industry and also those being made both publicly and privately in conservation and renewable energy resources. And I'm convinced that if we could devote the sort of energies that we're devoting to synthetic fuels to the other options, that we will perhaps solve the problems of those 5-million-barrels-per-day imports in the year 2000 and some of our other problems and perhaps faster.

BARRIERS TO DEVELOPING ENERGY EMANATE FROM ALL LEVELS OF GOVERNMENT

Senator **Hart**. Before Mr. Thoem comments, I think it's important to point something out here, because we talk about roadblocks and barriers and permits and licenses. I did not have a chance or take the chance to ask Mr. Slick or perhaps he didn't even know when he cited 160 permits and licenses for that project he mentioned, how many were Federal, how many were State, and how many were local. We had a curious phenomenon that when the energy mobilization board was put forward by the Federal Government to cut through Federal, State, and local redtape and delay and so on, that State and local officials strongly opposed it. And I think that bears some thought. I opposed it, too, frankly, because I'm just as afraid of some runaway, unconstitutional, uncontrollable board in Washington cutting through State and local laws.

But I have heard, for example, the famous Ohio pipeline that was going to be built from California east to move Alaskan oil from refineries in existence inside the interior, it was abandoned because the company got frustrated with permits and licenses, that the last permit and license had been acquired 11 months before the company decided not to build that pipeline. What it was frustrated by was California permits and licenses and county permits and licenses.

So all I want to do here is just intervene at this point on the whole issue of burdens and barriers in the development of energy to point out that this is a Federal system. And a lot of these barriers and so on are created by all levels of Government, not just one. And it's a tough situation to know how fairly you cut through a lot of that and reduce it when different levels of Government are opposed to one level exercising control.

BLANKET PERMITS AND REQUIREMENTS BURDEN ENERGY DEVELOPMENT

Mr. Thoem. If I could make two very short comments, one to Senator Soash. I didn't say it was impossible to build an 8-million-barrel-a-day industry. I was trying to put in perspective what the costs would be, given the law of the land in supplying that 8 million barrels a day and pointing out that, given all the existing law of the land, some things would have to change. Clearly, if it's in the interest of the State of Colorado and clearly if it's in the state of the Nation to develop a 20-million-barrel-a-day oil shale industry, if that's in their interest, we need to point out what their cost needs to be. EPA is more or less a puppet of the Congress and the State to implement those sorts of requirements.

I'd like to make a comment on——

Senator Hart. Some of us feel it's the other way around.

Mr. Thoem. There's a lot of passing the buck—comments on the permits and requirements. These sorts of numbers can get a little frustrating to me. We hear numbers of 100 or 160 or 700. Many of these numbers result from double counting and calling 1 permit 30 permits. For instance, the way the State department of health issues its air permit, Colony Oil Shale Development got 63 permits. If that's included in these numbers of 160, that doesn't place the right perspective.

We conducted an analyses of these more blanket-type broad permits and requirements that were necessary. We came to the number of around 40 to 50 total Federal, State, and local clearances that were necessary that had to happen. About 40 percent of those were environmental. The others were, "Send in your piece of paper, and you get your right of way." Of those environmental permits, they were fairly evenly distributed, Federal, State, and local. So the numbers tend to distort what's reality.

Mr. Markey. If I could answer that. In the recent symposium the Department of Energy sponsored in Vail, there was a discussion of the same points, and there was a large inventory of what all these permits were. And we tried to undouble count them at the same time. Pete Rutledge who is the area supervisor pointed out that in the oil shale area, there are perhaps four, five, or six, depending upon the type of facility and where it was being constructed, four, five, or six major permits that take a considerable amount of time and which usually generate controversy of one sort or another. And he also pointed out that no project in the prototype oil shale leasing program has been delayed 1 minute because of the absence of permits.

Senator **Hart**. Commissioner Cerise?

Commissioner **Cerise**. I feel quite a bit like Dick Soash does. Or at least the way I feel about it right now, we're looking at no 8-million-barrel-a-day plant. I think that this is going to proceed at a slower scale than maybe the impression some of the people have gotten. I think as we go along, we're going to solve a lot of these problems hopefully, and we will not destroy the western slope of Colorado. I have faith that somehow technology will be developed that we can do the majority of this without polluting the air, without polluting the water. And I think only time will tell. I think it's going to depend on what shows up at the first plants that they build.

Senator **Hart**. Thank you, Flaven.

Commissioner Schultz?

AIR QUALITY STANDARDS UNAFFECTED BY SMALL OIL SHALE INDUSTRY

Commissioner **Schultz**. Thank you, Senator. I have just one question. I would like to get the figures straight that Mr. Thoem and Kevin presented. You both feel, or am I incorrect, that the 400,000-barrel-per-day oil shale industry would not affect air quality standards?

Mr. **Thoem**. That's our conclusion; yes.

Mr. **Markey**. We accept that judgment based upon the assumption that best available control technology is used. And we do have some concerns, for example, about Oxy's current petition.

Commissioner **Schultz**. That is using today's known technology that we can accommodate that size of industry?

Mr. **Markey**. Yes.

Senator **Hart**. Tim, thank you.

Mayor Schultz?

Mayor **Schultz**. There's only one thing that hasn't been covered, and that's agriculture. If you keep holding up energy, how are these farmers going to keep up with this mass of population of people coming in at what we're going to do? And it's getting so now that these farmers can't operate profitably on the cost of fuel and the price they get. They surely can't produce dollar lamb and dollar beef and pay a $1.15 for gasoline and diesel fuel. So when you get down to brass tacks, you better see if holding up some of this might be very expensive to us in the future, because a lot of us might get hungry for that in the future.

Commissioner **Cerise**. I'd settle for that $1, $1.10.

STATE REVENUES FROM SKI INDUSTRY

Senator **Hart**. Mayor Slifer, do you have any estimates as to the amount of revenue generated by the ski industry in this State?

Mayor **Slifer**. No; I'm not sure I can. I think there might be some people in the audience that could, but I'm afraid I can't give you that number. It's now the fourth largest industry in Colorado as I see it.

Senator **Hart**. I see some hands being raised.

Ms. **Michaud**. Colorado Ski Country, which is a trade association for the industry, indicates that last year's season, which was the best effort, generated approximately $380 million to the State's economy.

Senator HART. $380 million?

Ms. MICHAUD. Yes; that's ski-related expenditures.

Representative THEOS. Well, that's the question I was going to ask you. Is that with your restaurant trade, everything?

Mayor SLIFER. That's everything; yes. Except real estate.

IMPACT OF INCREASED POPULATION ON SKI INDUSTRY

Representative THEOS. My question, I guess you're talking about with oil shale development and people coming in here, you'll have a lot of day skiers, so to speak. And how much will this impact your industry as compared to your out-of-staters or weekenders or week-long skiers?

Mayor SLIFER. If the population projections are correct, you'd have a million and a half people residing in this part of the State. The current ski areas and even moderate projections of expansion of those ski areas could not handle that kind of population pressure. There are a million and a half people on the eastern slope. If you couple that with who's here now, there's not going to be any room for visitors from out of State. The out-of-State visitor really spends the big dollar. They stay in the hotels, they eat out, they buy more things than an in-State skier. So the impacts would be dramatic, and the whole tone and the whole character of the ski community would have to change.

That holds true in the summer as well, summer recreation. Summer recreation facilities, national forest parks, public facilities, and towns would be just inundated. And I think the thing that we forget, too, is that with tremendous populations the cost of providing services is going to land squarely on the counties and towns. The industry is going to be gone. And once the towns are incorporated, once the industry is in the counties, the cost of providing normal services are going to lie squarely on the towns and counties.

Representative THEOS. In other words, if the oil companies would make these guys work harder and they wouldn't have time to go recreate, you'd be satisfied?

Mayor SLIFER. Well, it's a little beyond that.

400,000-BARREL-PER-DAY INDUSTRY SEEN AS ACCEPTABLE

Senator HART. Mr. Markey, you indicated that you now are willing to accept, or whatever phrase you use in the industry, in the range of 400,000 barrels a day. What are the reasons for that? I take it that's a change of policy in a part of your organization. Is that because you see it coming and it's inevitable or because you believe it's necessary?

Mr. MARKEY. Let's put it this way: We are willing to admit that such an industry will occur. I can't say for my constituency that I am willing to accept that. But if we are going to have any development at all, an initial 400,000-barrel-per-day industry, as long as it's diverse and individual operators don't monopolize the show, will be a responsible direction to go.

There are some additional things that have to happen in that, and that's that we've got to learn something from that industry. Unfortunately, there is relatively little which is required by law in terms of learning something of that industry. You've got the prototype program with its extensive monitoring, but private operations on private tracts will not necessarily have to make available data or make measurements through monitoring which will be publicly accountable and which will be able to be used by decisionmakers in the future.

I think that the bill which you introduced at the beginning of this session which would have required monitoring and would have required access of researchers to oil shale facilities is a very important concept.

Senator HART. If there are no further questions, gentlemen, you have the thanks of the committee and this panel. We appreciate your testimony.

Our third and final panel has to do with the issue of community development and the effects. One of the people in our platform is now going to put on a different hat. Commissioner Schultz is a member of this panel as is Mr. Steve Schmitz, Colorado Department of Community Affairs. I guess Dr. House is coming back from DOE, and we will have Mr. William McDermott, Rocky Mountain Oil and Gas Association.

It's our intention to hear from this panel and ask questions, perhaps complete our work on this question by about 2 o'clock. We've offered to Mr. Slick an opportunity to in effect reappear and comment on any of the testimony that we've heard today in case he wants to clarify the record as to his company's position.[1] That would occupy some 15 minutes perhaps. And it's our hope to adjourn the hearing by about 2:15 p.m.

So we'll start with Mr. Schmitz representing the State of Colorado Department of Community Affairs. And we'll urge all of you to summarize to a degree possible.

STATEMENT OF STEVE SCHMITZ, COLORADO DEPARTMENT OF COMMUNITY AFFAIRS

Mr. SCHMITZ. Thank you, Senator. I appreciate the opportunity to be here and will try to be as quick as I possibly can.

First of all, I would like to just add to the statistics and add some more meganumbers to those existing regarding the 8-million-barrel scenario.

Before I do that, however, I would like to state that we are concerned about the fact that we are seeing at least a fair level of detail being put into how the industry will be developed in terms of where the water is supposedly going to come from, numbers of individuals required, types of mining that may be necessary, and the like.

Although we have heard from various industry officials that they feel that community impact and community assistance, are very important aspects of their mining, to date there has not yet been the kind of detail put to the types of community assistance that are going to be required, kinds of investments and the like, to give us a feeling of full confidence that these will occur.

LONG-TERM CHAOS RESULTS FROM SHORT-TERM PLANNING

We feel strongly about the fact that various levels of government, and the industry itself, should be extremely concerned about the status of the communities in which the employees are going to live. From the standpoint of the State and certainly local governments, we are concerned because we know that if we don't do the job correctly and we don't have the proper amenities in communities, the social unrest that will beset us will be extremely costly and very difficult to resolve.

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[1] See p. 253.

We're concerned that if we don't build our communities to existing standards of planning, design and human services we will create instant, immediate, long-term large slums that ultimately will require going back in and renovating before we reach a state of equilibrium.

From the standpoint of the Federal Government and the industry, we think that unless the communities are built up to the point to adequately accommodate this population, the Federal goals cannot be reached and that the industry profits cannot be made. We have a fairly good example of that occurrence in what happened with the construction of Bridger 2 and 3 at Rock Springs, Wyo.

We are given to believe that during the construction of that particular plant, which was also happening coterminously with a large buildup in the Trona industry which pulled away all of the available housing for new construction workers for those two units, the construction force when it arrived was forced to live in what we now know as infamous living conditions. We know that the Bridger plant turned its population over three times during the 5-year construction life of those units. We know that it took 5 years instead of the originally set 2½ years to build those units, and we know that it cost approximately $1.2 billion instead of the original $700 million the project was slated to cost. We think that makes a good case for us.

We know that if Pacific Power & Light had invested 10 percent of their original production cost, $70 million, in the community of Rock Springs, they could have easily saved the additional $430 million they spent solely on the basis of employee turnover and the problems attendent to a dissatisfied work force.

Further evidence to that shows that when Pacific Power & Light built their Bridger 4 plant, Rock Springs was in a relatively good position to accommodate their work force, and construction came in both underbid and ahead of schedule. The study that was done goes on to state that the key element involved in that was the status of the community and the relative satisfaction of the work force to allow them to be more productive.

I would like to cite for you if I may some of the things that we will need according to the standards that we've developed in our office to accommodate 1.65 million, population level in this area. We'll need a raw and treated water capacity of 300 million gallons per day, a storage capacity of 1.6 billion gallons. We will need to have treatment of sewage of 165 million gallons a day. We will have to have administrative and teaching staff of 19,800 to staff 413 elementary and 165 high schools.

To transport those students, we will be using 3,300 buses. We will need 5,775 additional policemen and firemen. We will have to expand facilities required by police and fire by 825,000 square feet. We will need 1,155 police cars and fire trucks.

Senator HART. Is this the population base of—what?

HUMAN SERVICES

Mr. SCHMITZ. Population base? It assumes 1,650,000 individuals.

Local government will have to expand its current staff by 6,188 individuals. It will have to add space of 866,250 square feet. It will have to purchase equipment for $49.5 million and make investments in material such as streets, curb, gutter, drainage and the like for $1.65 billion. We'll need 1,615 in medical personnel, of which, 40 percent will be physicians. Clinical space will have to be increased by 990,000 square feet, and hospitals will have to add 4,043 beds.

Other human services, which include the broad range of human services, traditional human services provided the counties, physical rehabilitation, developmental disabilities, et cetera, will require staffs of 8,250 new people and additional square footage to their present capacity of 2,475,000 square feet.

Parks and recreation staff, primarily of a maintenance variety will have to be increased by 1,073 individuals and 16,500 acres of land will have to be found to house the parks and recreational facilities.

Last year Governor Lamm instituted a panel of businessmen, government and industry officials, to take a look at the long-range future of the State of Colorado and what we are going to have to go to continue to assure its economic viability. My office staff have taken some of the calculations that panel has made for public investment and has applied that to the population base of 1,650,000. We have come up with a total capital cost for local and State governments of approximately $21 billion for this production and population level. And this does not include $1 billion operational funds per year to run those various facilities.

SYNTHETIC FUELS SECURITY CORPORATION PPROVIDES RISK-FREE ENVIRONMENT FOR INDUSTRY

Senator, I think that another thisg we find somewhat bizarre, asd perhaps you do too, surrounds the basic idea that the Federal Government has, through the provision of $20 billion in the form of Synthetic Fuels Security Corp., virtually created a risk-free environment for the industry to develop synthetic fuels. yet the debate has lasted for 5 years for impact assistance totaling $450 million. These are not Federal give-away programs. We think that it is absolutely necessary that the Federal Government help us or participate with us in meeting its goals for energy production independence.

Thank you very much.

Senator HART. Thank you.

PREPARED STATEMENT OF STEVE SCHMITZ, COLORADO DEPARTMENT OF COMMUNITY AFFAIRS

The purpose of this testimony is to make a rough estimate of the community development costs which include public infrastructure, service, and operational costs attendant to an 8 million barrel per day (bpd) oil shale industry and the 1,650,000 people such an industry will generate.

Before beginning the enumeration of specific impact costs, it is necessary to point out that the development of an acceptable living environment for the present residents, direct and indirect oil shale employees, their families, and generations to come should be the paramount concern of both government and industry.

Local and State government are concerned because we have learned the lessons of the microcosmic examples of other modern day boom communities. We are aware that if we do not provide basic community amenities then the social unrest and the steps we must take to rectify that unrest will be visited upon us in the form of police, mental health, alcoholism treatment, medical and other social service costs which exceed normal costs of equal populations by several hundred times. We also realize that if we do not build communities which conform to accepted planning, design and human service standards then we will be faced with the prospects of immediate slums and long-term costly renewal projects before we can reach equilibrium.

The Federal government and the industry must be concerned because, if the public service infrastructure is not in place and the dire prospects of boom communities at their worst become a reality, then national production goals for oil shale will not be met through failure of the industry simply to keep its trained manpower on the job long enough to maintain construction and operational schedules.

This phenonemnon is best described in the experience of Pacific Power and Light in its construction of units 2 and 3 of the Jim Bridger electric generation plant near Rock Springs. Because of rapid build-up in the Trona industry, all available housing was occupied prior to the power plant construction work force arriving. When the construction work force arrived, it was forced into what have become infamous living conditions.

The upshot of this was that P.P.&E. turned over its work force 3 times during the construction life of the project. The construction schedule took close to 5 years, instead of the projected 2-1/2 years and the costs rose from a projected $700 million to an actual cost of approximately $1.2 billion.

Had P.P.&E. invested 10%, or $70,000,000, in Rock Springs for community development, their overall savings could have been approximately $430,000,000.

Unit 4 of the Bridger Plant was constructed ahead of schedule and under bid. A follow-up study concluded the key difference to be the state of readiness of Rock Springs to accommodate the growth.

The concept of impact assistance for local and State governments is substantially more than Federal government giveaways or philanthropy on the part of industry. Impact Assistance is integral to the successful meeting of national goals and industrial profits.

In order to provide good community amenities, we will have to construct between now and 2010:

COMMUNITY FACILITY AND SERVICE STANDARDS

Domestic H_2O Systems		
Raw Water Supply	330,000,000 ~	330 Million G.P.D.
Treatment Capacity		330 Million G.P.D.
Storage (Raw and Treated)	1,650,000,000 ~	1.65 Billion G.P.D.
Distribution		600,000 Taps
Sewer Systems		
Treatment	165 Million Gal.	
Collection	600,000 Taps	
Schools		
Staff	19,800 (Teachers/Staff)	
Schools:		
Elementary	413	
High	165	
Buses	3,300	
Police and Fire Protection		
Staff	5,775	
Space	825,000 sq. ft.	
Vehicles	1,155	

Local Government	
Staff	6,188
Space	866,250 sq. ft.
Equipment	$49.5 Million
Materials (Streets, etc.)	$ 1.65 Billion
Medical	
Staff (.6 Staff/ .4 Physician)	1,650
Clinic Space	990,000 sq. ft.
Hospital Space	4,043 Beds
Other Human Services	
Staff	8,250 Persons
Office Space	2,475,000 sq. ft. ~ 2.48 Million
Parks/Recreation	
Staff	1,073 Persons
Parks (Land)	16,500 Acres
Housing	
Total Units	600,000
Single Family	(57%) ~ 342,000 Units
Multi-Family	(17%) ~ 102,000 Units
Mobile Homes	(26%) ~ 156,000 Units

Last year Governor Lamm constituted a panel of business, industry and government leaders whose purpose was to evolve the best available forecasts as to what the capital and operational investments would have to be to assure a continued viable future for Colorado. Their estimates, adjusted for impact specific circumstances put the total public capital costs for an 8 million bpd oil shale industry at $21,078,750,000 and annual operational costs at $1,881,000,000.

Senator HART. Mr. Schultz?

STATEMENT OF TIM SCHULTZ, COLORADO WEST AREA COUNCIL OF GOVERNMENTS

Commissioner SCHULTZ. The issue of oil shale development in our region is becoming increasingly important to the people of our area. I very much appreciate the opportunity today to come before you and the committee to discuss the local concerns and the feelings that we have as the people that must face the onslaught of the things such as the State of Colorado has just talked about.

The Colorado West Area Council of Governments is made up of the counties of Garfield, Mesa, Moffatt, and Rio Blanco. Our region recognizes the need to develop the Nation's energy resources, specifically those found in our area. We're willing and very much ready and able to help and to accommodate reasonable levels of development. But at the same time, we're very concerned that the State, the Federal Government, and industry must recognize their responsibility in our area.

One of the most important things that a forum like this brings out is that we can talk about water problems, we can talk about air problems, we can talk about a vast number of things, but if the entire problem is to be solved, we have to work at it together. And the people problems, the socioeconomic problems, have to be addressed. They have to be addressed on the same scale as an air quality problem. It can't be that the Federal Government can set a certain limit on air quality and industry will say, "We'll meet that air quality. We'll develop the technology to meet that." We have to set the same kinds of parameters on our socioeconomic problem and industry must respond.

Industry, the Federal Government and the State government have to be willing to comprehend and meet those problems head on just as they do the air pollution and the water-type problems.

REGIONAL SOCIOECONOMIC PROBLEMS

To date, our region has been planning for an oil shale industry of approximately 200,000 barrels per day. We've heard today from the Friends of the Earth that they're now willing to accept the 400,000-barrel-per-day industry as what is going to happen here. We haven't even begun to address the issues that we would have to in a 400,000-barrel-per-day industry.

In a 200,000-barrel-per-day industry, our population will double by the year 1990. That means an additional 100,000 people would have to be accommodated in our area. Communities will grow three, four, possibly five times. As an example, Rifle can expect to grow from an estimated 1980 population of 3,540 people to 19,573 by 1985. This, again, is assuming a 200,000-barrel-per-day operation, not 600,000, 400,000, or a million.

Meeker could reach a population of over 10,000 people by 1985. This level of growth without a doubt will create great economic activity. There will be many jobs. It would bring many opportunities for a large number of people. But there are also tremendous negative impacts, negative features, that come with this growth. We have a tremendous increase in crime. We've already experienced that. High inflation and severe handicaps on the elderly are some of the worst problems that we have. The elderly become displaced from their homes. They can no longer afford an apartment, and the local governments are faced with a situation of taking care of or finding alternatives for these people.

FRONT-END FINANCING ESSENTIAL TO OFFSET SOCIOECONOMIC PROBLEMS

These problems will be compounded if there's not adequate funding on the front end or the financial assistance necessary to deal with them. Recent energy and Federal incentives have made this scenario, the 200,000-barrels-per-day scenario, probably too low. Again, we've heard today that 400,000 is now the accepted figure. How do we deal with that? We must begin to do better planning. We must begin to address the issues of financing this industry and the socioeconomic problems.

I'm going to give you a few figures that we've developed locally on what it would take to accommodate the 200,000-barrel-per-day scenario versus the 8-million-per-day Exxon scenario that's been talked about. In order to accommodate 200,000 barrels per day, we in this region will have to grow by 7,018 people per year. If we're to go to the larger scenario, we would have to grow 50,000 people per year.

We would need under 200,000 barrels a day 2,611 new housing units annually. Under the larger scenario, 18,000. We would convert 326 acres of land annually versus 2,250. We would need in the area of 28 policemen versus 200, 3 new schools a year versus 20 new schools annually, 2 new parks versus 13. We feel that we can manage a program of approximately 200,000 barrels a day. It will be very, very hard. The money is not here today to do it. We feel, as Representative Theos has talked about, that when the ski industry came in, the uranium boom, oil in the Rangely area, these things were accomplished through the hard working of the local people. We feel we can accomplish this 200,000-barrel-per-day industry with some Federal help, with State help and some local help.

But if we talk of the large scenario, we will be buried. I don't think it's appropriate at all, but we can talk about it.

One way to bring the whole thing into perspective is that under the 200,000-barrel-per-day scenario, we would need to add one town the size of Glenwood Springs annually to accommodate this growth up to the year 2000.

If we go to the large scenario, we have to add Grand Junction to this area every year until the year 2000. And I honestly don't think that that can happen. I think it's impossible to adequately accommodate the growth associated with that large of an industry. I'm not positive that we can adequately address the growth of a 400,000-barrel-a-day industry. I am positive that we would work very, very hard to do that since that industry would be a viable thing that could work in this area. But there would be many, many problems that would come along with it.

COUNTY IMPACT COMMITTEES

To date we've done a number of things to work toward a better local responsibility in handling this problem. We've developed employment projections which we update regularly. We have good communications with our industry people on their employment. We use these to justify our needs, to set our priorities, and to plan from.

Each county has established impact committees which are sensitive to the communities' needs. These impact committees are made up of a broad section of the people within the communities as well as State, Federal, and industry representatives. We have put on a large number of highly qualified professional staff people within the county, and within the small towns in an effort to gear up for the coming of this industry.

We feel in region XI that we're in the best possible position to assess local impacts. We think that it has to be mandatory that local input is put into the decisionmaking process at the State level and in particular at the Federal level. As local elected officials, we feel that the Federal Government finds it very easy to set goals, to set numbers of barrels of oil shale that's needed without taking into consideration how those numbers will be reached. And this is the important thing that we have been trying to and want to stress, that if we want a 400,000-barrel-per-day oil shale industry, we need to get together with the Federal people. They need to come out here and talk to us and see what our needs are. We feel we can put it down on paper what we need. And those are the type things that have to be addressed. We have to have a plan to work from. We can't be batting in the dark with mountains of figures and expect them to be met.

Local government, in light of the vast changes that are coming about in our area, is becoming more vocal than it has been in the past, and we're becoming better educated through experience. Local government will demand that industry pays its way in the future. Local government will demand that the Federal Government and the State governments play a more active role in participation in solving the problems. If industry and the Federal Government and the State government are willing to do this, we will meet the needs of this country.

With that, I'll close and attempt to answer any questions that you should have. Thank you.

Senator HART. Thank you very much, Commissioner.

PREPARED STATEMENT OF TIM SCHULTZ, COLORADO WEST AREA COUNCIL OF GOVERNMENTS

The issue of oil shale development is taking on greater importance. As we begin the decade of the 1980's, oil shale's importance to the nation will bring significant impacts to the counties of Garfield, Mesa, Moffat and Rio Blanco and their incorporated municipalities which make up the Colorado West Area Council of Governments. The commitment of the federal government to synthetic fuels development has come about as a reaction to the instability in the mid-east, OPEC's dramatic price increases for crude oil and the threat of a shut-off of oil from the mid-east.

All indicators point to ever increasing emphasis upon the development of our nation's oil shale and coal resources, vast amounts of which can be found in our Region.

Our Region recognizes the need to develop our nation's energy resources and specifically those found in our area. We are willing to accommodate reasonable levels of energy development and assume our share of the responsibilities associated with mitigation of rapid growth problems related to energy development. At the same time, Colorado, the federal government and industry must recognize their responsibility to this area. We will address this point in greater detail later.

The Region to date has been planning for an oil shale industry of approximately 200,000 bls/day (BPD) by 1990. This probable scenario included development of commercial scale oil shale facilities by Union, Colony, Superior, Cathedral Bluffs Shale Oil Project and Rio Blanco Oil Shale Project.

Development of a 200,000 BPD industry by 1990 will bring a near doubling of the Region's population by 1985. This means an addition of 100,000 people in the area within the space of five years. Some communities can expect their populations to increase by factors of 3, 4 and even 5 times their present size.

For example, Rifle can expect to grow from an estimated 1980 population of 3540 to a population of 19,573 by 1985. Meeker could reach a population of 10,693 in 1985 compared to 2606 of today.

This level of growth will bring with it great economic activity and many jobs, but at the same time it will bring the negative features of rapid growth such as increases in crime, high inflation, severe hardships on the elderly, shortage of goods and services and generally a diminishment in the quality of life. These problems will only be compounded if there is not adequate planning and front-end financial assistance available to deal with them.

Recent energy company pronouncements and federal incentives may make this probable scenario too low. It is too early to tell at this point in time if our estimate is, in fact, too low. Perhaps, as Exxon envisions, the oil shale industry in this area will reach a 2,000,000 BPD level in the year 2000 and 8,000,000 by 2010.

The following table compares the magnitude of growth associated with the CWACOG probable scenario at 200,000 BPD by 1990 with its magnitude if the Exxon scenario were to come true.

	CWACOG Scenario	Exxon Scenario
Population increase per year	7018	50,000
New housing units required/year	2611	18,000
Acres of land converted to residential usage/year	326	2,250
New policemen required each year	28	200
New schools/year	3	20
10 acre parks/year	2	13
	Equivalent to adding a Glenwood Springs and its service area each year.	Equivalent to adding a Grand Junction and its service area each year.

It will be difficult enough for the Region to deal with the growth associated with an industry of 200,000 BPD by 1990. It would be impossible to adequately accommodate the growth associated with the Exxon scenario.

The Region has been preparing for an oil shale industry of approximately 200,000 BPD by 1990. The Region's preparation has included the following important activities:

1) The area recognized that it needed to develop a mechanism to predict growth projections for the area's communities and counties. The CWACOG developed a projection model, driven by employment projections provided by the industry.

2) Each county has established impact committees to assess community needs, programs and implementation strategies. The impact committees reflect a broad cross-section of the communities and also have as members representatives of state government, federal government, Colorado West Area Council of Governments and industry.

3) Local government has also been developing local professional staff capabilities, including town managers and planners. At the same time, we have been preparing local comprehensive plans, growth management tools, capitol improvement plans and regional plans.

We in Region XI feel we are in the best position to assess local impacts and what will be required to properly deal with them. Also, we recognize our responsibility to the nation to allow development of the energy resources at our doorstep, but we should have an equal voice in determining the rate at which it will be developed. The State of Colorado, the federal government, and industry must also recognize their responsibility and stake in assisting local government in our efforts to maintain our area as a healthy, viable place to live. Everyone loses if our area becomes an unpleasant place to live -- industry faces higher costs, our national energy goals will not be met, and the state faces higher costs associated with redevelopment.

Since the area is largely rural in nature, consisting predominately of small communities with limited tax bases, severe tax lead time problems and statutory limits on tax increases and indebtedness, timely outside financial is critical.

The state must continue to provide timely financial assistance with funds derived through state severance taxes. Funds which flow to the state through the Mineral Leasing Act of 1920 must be distributed to impacted local governments in greater proportion than is now the case. It must be recognized that if the state does not pass through mineral leasing funds in accordance with the federal intent that they go primarily to impacted political subdivisions of the state, then we run the very real chance that further federal energy impact assistance may be jeopardized.

The federal government must recognize that its initiatives and incentives are the primary motivating factor for increased oil shale development in the area. Because of this, it must be prepared to provide adequate financial assistance to the area in a timely fashion. New legislation providing financial support to energy impact areas, such as Title III of Senate Bill 2332, is required. Also, existing federal programs must be directed at providing more assistance to energy impact areas, especially while there is no specific program of assistance which provides funds for oil shale impact areas. Also, the federal government should allow energy companies seeking loan guarantees for synthetic fuel projects to cover impact mitigation measures as allowable expenditures covered by such guarantees.

Industry must recognize its role as a good neighbor and provide timely financial assistance to existing communities and counties to fill in the gaps not covered by local, state, and federal revenues. This is, of course, in their own best interest. Local government expects industry to pay its own way. Industry commitment to housing and transportation programs aimed at impact mitigation are especially important.

Beyond financial assistance, local government expects from both the federal government and the State of Colorado an equal voice in formulating decisions which directly affect them, especially as this relates to the level, timing and policies regarding energy development. Local government also expects from industry timely information on development plans and employment levels, so that it has sufficient time to prepare for the associated impacts. Also, the federal government and industry must respect and abide by local land use plans and regulations. This is critical to accomplishing orderly, well managed growth.

In summary, local government is mindful of its obligation to assist the nation reach a greater level of energy independence and therefore allow for reasonable levels of energy development to occur and impact the area. Local government will do what it can to maintain the existing quality of life which makes this area unique. But this can only be done if local government is made an active, full partner in the decision making process and receives adequate front-end financial assistance from state and federal governments and the industry. This goal, as well as the energy production goals of the nation, can only be met through cooperation and coordination at all levels, both private and public.

Senator **Hart.** Mr. William McDermott, Rocky Mountain Oil & Gas Association.

STATEMENT OF WILLIAM F. McDERMOTT, ROCKY MOUNTAIN OIL & GAS ASSOCIATION, INC.

Mr. **McDermott.** Thank you, Senator. It is a pleasure to be here today. I'm a resident of Grand Junction, Colo., so I must speak today partly I guess as a citizen of western Colorado. I'm also executive vice president of Occidental Oil Shale. So I'm going to probably give some inferences here about the guy that's trying to product the 1st barrel rather than the 8 millionth barrel. And third, but not last, as chairman of the Subcommittee of RMOGA, Rocky Mountain Oil & Gas Association, which is devoting its full time to addressing the issue of community affairs.

The purpose of this committee, that's been constituted under RMOGA is to look at socioecenomic aspects of the development of the oil shale industry and to relate to the community, and counties in the State that are involved in those issues.

This committee will hold its meetings in western Colorado, and it is going to be moving around throughout the districts in order to have firsthand discussions with the communities and the counties on those issues that are of interest.

FOUR CATEGORIES OF OIL SHALE DEVELOPMENT

I characterize the development of oil shale in four categories. The first is that you have to acquire some land. That's a phase of a lot of the companies today are in or have just passed through. The second is what technology is going to be used to develop that land. You can see that several are in that category. That third is then the economics, is it a viable thing to progress on. That fourth one is the people problem. And, unfortunately, it is fourth. It isn't until you get deeply into that fourth issue that you really understand the problmes tha are associated with it.

GROWTH OF OIL SHALE INDUSTRY DICTATED BY PEOPLE ISSUE

You also come to the realization that any oil shale industry is not going to move very far without people. And, therefore, the people issue is very much deep-rooted into the whole viability of the project. It's my opinion that it's not air, it's not water, it's not money, but it is people that really will dictate the rate of growth in the oil shale industry in Colorado.

You come to the conclusion that one must be deeply concerned with the environment that is in western Colorado. There are two things that any prospective employee asks. One is what's the job pay. The second is what are the living conditions like. So we must insure that adequate living conditions are in place. And when I say we, I'm speaking of the industry and the community.

I was really quite pleased when I came here to the western slope 2 years ago to see the intimate relationship between industry and the communities in the way that they were trying to work out these problems. There's been a lot of individual efforts, and there's been efforts in the mitigation task forces Tim just spoke about which not only involve the oil shale industry but also the coal industry and the power industry which are also impacting these areas.

We've been very active in helping to get those committees going and keep them going. And I think they are a very vital part of the activity here. They really perform three major functions. One is an information function where industry can input to the community and the community can input to the industry. The second is that it helps to identify needs. And, third, it helps to look at the funding problem associated with those needs.

EFFORTS OF INDIVIDUALS AND INDUSTRY TO ASSIST IN ORDERLY GROWTH

Certainly, on the question of needs, the oil shale industry has been very supportive in the utilization of the oil shale trust fund and in the development of projects that are to be presented to the Joint Budget Committee for approval and have participated in those hearings to help the counties and the communities to get their point of view across.

Also, the industry was very supportive of the addition of the severance tax to the oil shale. There will also be royalty paid from the productive development of the Federal tracts. And as an example of that, in our own case at CB, we're talking about $17 million a year in 1980 dollars would be going to the State fund.

The industry also endorsed the proposition to enhancing the viability of making available front-end funds to impacted areas. Your efforts, in this regard, Senator Hart, are very commendable, and we support them.

A recent study produced by the Peat, Marwick, Mitchell accounting firm for RMOGA, addresses the issue of the tax revenue flow created by different type plants located at different places in the Piceance basin. A 100,000-barrel-a-day plant was used. From that size plant, in 1980 dollars, over the first 25 years, there's some $6 billion of taxes generated. Approximately 10 percent of that would go directly to the local community. That's a lot of money. The problem is that it doesn't occur until after production starts and the need is occurring right now.

There's been a lot of individual effort on the part of various companies to assist in an orderly growth. Certainly the Rio Blanco Oil Shale Co., Northern Coal, Colony project you've heard about this morning, and ourselves at Cathedral Bluffs, have all taken a very strong and pro active view. C–B has provided technical assistance to the communities and the counties through the use of an outside consultant. The planners, and the administrators, can call on that consultant to help them in any of their work they have underway. We're paying the bill, but they are getting the benefit.

C–B provided planning guides to both Meeker and Rifle through that same consultant that cost well over $200,000. We believe that the planning part of this is vital and that a very strong discipline has to be in place in order to see that good plans are enacted and then that they are properly administered.

GOVERNMENT REGULATIONS SLOW GROWTH OF INDUSTRY

I think one thing that comes out of the meeting today is that really you need some timing perspective put to these projects. For example, the first No. 2 shovel that was stuck in the ground at C–B was back in September 1977. It will not reach full production until 1990. Now, that's some 13 years. Some of the other operations can have a shorter startup than that due to the fact they do not have to sink shafts to access the oil shale resource. But it is a long-term type operation. In addition, new operations coming in today, have to go through the permitting phase.

There's a lot of Government decisionmakers that exercise a tremendous amount of control on the rate at which that industry will grow. And I think the scare stories are just that, and I think they do a lot of injustice to the people here in Colorado that are working on these problems. And all they're doing is creating more problems, increasing land costs, and so forth.

Oil shale is going to create a change, there isn't any question about it. But what we've got to do is insure there's quality growth, and that's a challenge to all of us, both the community and the industry. Thank you.

Senator Hart. Thank you, Mr. McDermott.

PREPARED STATEMENT OF WILLIAM F. MCDERMOTT, ROCKY MOUNTAIN OIL & GAS ASSOCIATION, INC.

Mr. Chairman and members of the Panel, my name is William F. McDermott. I am Executive Vice President of Occidental Oil Shale, Inc. I am also Chairman of the Community Affairs Subcommittee of the Committee on Oil Shale of the Rocky Mountain Oil and Gas Association, Inc. The membership of the Rocky Mountain Oil and Gas Association, Inc. numbers about 750 companies; the Committee on Oil Shale comprises the full spectrum of those companies with interests in oil shale development in Colorado and Utah.

The Committee wishes to commend you, Senator for your sponsorship and advocacy of oil shale initiatives. We are very thankful for your assistance in the passage of the $3 per barrel income tax credit, your sponsoring and leadership on the floor of the Senate of amendments designed to improve the economic climate for oil shale, your sponsorship of legislation to assist local communities with the impacts associated with oil shale development, your co-sponsoring S.2783 along with Senators Wallop and Garn to bring oil shale tax treatment up to an equal level with other synfuels, and your leadership as sponsor of legislation to allow off-tract access to federal lands for oil shale lease holders. This is a long and impressive list of measures and accomplishments. While we recognize that you have other constituents, we are proud of our relationship and look forward to your continued support in the future.

On behalf of the pioneering oil shale industry, I thank you for the opportunity to appear before you today. I hope this meeting will reaffirm our commitment to the development of a new energy industry and a new energy resource that will provide a major supplement to America's domestic energy supplies in a manner compatible with our concern for protecting the environment. The nation and the oil shale industry are opening new ground, literally and figuratively; we must do so with a mutual anticipation of both the opportunities and consequences of our actions and decisions. Thus, this hearing is important.

We are here to discuss the potential for development of oil shale in the future; and to do so, we should start on common ground. First, and most obvious, American desperately needs to enhance her domestic supplies of energy. Oil shale offers the most promise of providing substantial amounts of synthetic crude oil which can be directly substituted for conventional petroleum products at a price competitive in today's market. Indeed, oil shale offers the most ready means for American to provide a secure domestic sources of supply for our armed forces, a subject which is especially important to you and your colleagues on the Armed Services Committee. The shale is there as a known resource. With today's technology, oil shale is more economical than any other alternate to conventional petroleum liquids. Thus, it is in the best interest of the people of the United States to produce a maximum amount of oil from shale at the earliest possible date.

The first concern that many people have in connection with development of oil shale is its environmental and socio-economic impact. Some people have demanded that shale oil production should not, cannot and must not make any impression or change on the quality of life or the way of life of any individual or community. We can appreciate that position, but we must also recognize that any kind of development - even on a modest scale, will bring changes to the rather small geographical area in which it takes place.

Development of a shale industry will present great challenges to all of us; one of the most important of which will be to assure that development moves forward in the least disruptive manner. But, we must all recognize that any growth of any kind will cause change. I can assure you that we will all strive to protect the environment and the way of life in the areas of Colorado and Utah where we will live and work; but we must recognize that there will be change. There has been considerable change in the local communities in Colorado and Utah in the last ten to fifteen years which is solely attributable to the growth in tourism, not resource development. The future holds more of both, and it is not necessarily bad.

A second major topic for discussion is the question of limits and constraints on this new industry. These fall into two broad categories: (1) the physical/technological limits to development, and (2) the political limits. The second category is the more important.

Mr. Chairman, it seems physically and technologically feasible to have production in the millions of barrels a day in the foreseeable future. That is a far cry, however, from what we see in today's political environment.

Significant numbers of restraints on the industry have been set out which have caused companies to either abandon or significantly restrain their hopes for development of their oil shale operations. In recent months, however, the climate has improved. The oil shale industry will be the first major new industry to be developed under the strict controls of numerous new pieces of legislation. Among those new laws are the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, the Federal Land Policy Management Act, the Endangered Species Act, the Antiquities Act, the Wilderness Act, the Safe Drinking Water Act, the National Environmental Policy Act, and the Surface Mining Control and Reclamation Act. Recently, we have seen Congressional approval of oil shale development and companies are encouraged.

We in industry have consistently maintained, since the Committee was formed in RMOGA many years ago, that the question facing government and its leaders is not whether oil shale would be developed, but when it would begin and at what pace. We face a choice between allowing oil shale to be developed at a reasonable, gradual pace or on a crash basis later in the face of a crisis. These delays in the timing of shale's development can be directly translated into increased costs due to heavy impact of inflation on such capital intensive projects. Only companies with significant amounts of optimism and money have been able to bear those burdens. While industry may be accused of not being able to move forward with the development of these projects due to the economic climate in which we exist, the economics have been signficantly determined by the political environment in which we must live.

The companies nearing development have had permit applications on file for many years with the state and federal authorities and are now in a position to move forward with plant development. Other companies are currently evaluating their posture in oil shale who possibly have a significant resource position, but have not engaged in background monitoring necessary to begin preparation of an environmental impact statement. These companies are many, many years away from being able to build a plant and yet possess large amounts of technical and financial abilities and could make a more significant contribution in a better regulatory framework.

The Clean Air Act in our opinion, and our position in this is supported by the recent study done by the Office Technology Assessment for the Congress, will limit production of oil from shale in Colorado. Until the first plants are actually developed no one will know precisely what the effect in the Piceance Basin and the Flattops Wilderness Areas will be. We think those impacts will be manageable and indeed a positive influence on the area if a new spirit of cooperation can be forged between government and industry to manage them properly.

There is a good possibility that the simultaneous development of oil shale projects, coal developments, tar sands production, uranium production, desulfurization of natural gas production, and the development of the MX missile system will use all of the increments available under the PSD regulations and the Clean Air Act. This makes the competition for these increments quite strong and more importantly, makes the future size of these developments questionable. The Clean Air Act should be revised to remove this uncertainty.

Water quality and water supply are continually referred to as problems which will limit the size of an oil shale industry. We feel that the State of Colorado's recent study clearly indicates that an industry of 500,000 barrels per day will not require tradeoffs to be made between agricultural and industrial or municipal use. That is good enough for starters, and we are confident that as the technology advances ways of reducing water requirements will be developed which coupled with full utilization of available water supplies will permit an oil shale industry much larger than 500,000 barrels per day.

Turning to the socio-economic impacts of an oil shale industry, the industry has made significant commitments to assuring the people in the affected areas that industry will do its utmost to cooperate with federal, state and local officials and to ensure that planning for the expansion of the infrastructure in the local communities is done as development proceeds. Indeed, industry supported 4% severance tax in Colorado to finance the cost of its presence in the State. We are very proud of having been that responsive to the concerns of the officials at the local and state level, and think our commitment is demonstrated by our support for the tax. A 4% tax on the gross value of the plant's product is going to accrue huge revenues to the State of Colorado, and we think offers an opportunity to assure that those concerns will be addressed adequately. Make no mistake Mr. Chairman, this signifies a deep, unabiding, and tangible commitment to seeing oil shale developed right the first time. Some developers have committed themselves to constructing new communities to provide single family homes that are attractive and beneficial contributions to the local communities, rather than simply parking trailer homes in orchards, as we've seen in the area in the past with other kinds of growth. Other developers are taking positive steps to help the communities meet the needs of a growing population. There will be change, no doubt about it. But, it can be progress rather than boom-towns. We intend to work for that.

Also, the Committee on Oil Shale has retained the accounting firm of Peat, Marwick, Mitchell and Company to quantify the revenue flows from a commercial scale oil shale plant to local, state and federal governments. We undertook this study to provide a service to communities looking at future revenue requirements, and to provide a tool for future revenue planning. The study is in the final stages and will be available to you and other interested people in the near future.

We submit that our estimates of the size of an industry have two perimeters, the technological and physical perimeter which is very large given the nature of the resource base, and the other is the political perimeter which is presently untested and unknown. The critical need is to begin development of shale oil industry now. The initial plants must be large ones of a commercial scale of approximately 50,000 to 100,000 barrels per day. The President's goal of 400,000 barrels per day by 1990 is attainable if we proceed with the pioneer plants in a timely fashion. With the information and experience gained from these first generation plants, we feel we can multiply that figure several times and still meet all reasonable environmental parameters. Beyond that, while we don't know how large the industry will become, we must begin now to plan for an industry of sufficient size to meet the nation's needs during the 1990's and beyond. To do this, we must move ahead with plans for the second and third generation plants even while the first are being built.

We submit that the capability is physically much greater than the President's goal, given the size of the resource, and would remind you of the tremendous potential for technological advances in the second and third generation of plants. These advances will quite probably make today's problems seem incidental. But the only way to find those answers is to begin today. As I mentioned earlier, we need a new spirit of cooperation between government and industry to manage the impacts of a growing industry. Such a partnership must have the resolve to look into the future and adequately plan for both development and impact absorption if it is to succeed.

Obviously, the questions of environmental tolerance and socio-economic impact will influence the level of growth of the industry. Which level of production is more appropriate for America, for the region, and for Utah and Colorado are not questions we can answer. Those are questions which must be decided in public forums, and we appreciate the opportunity to be a part of such a forum today. In the meantime, we stand ready and most willing to assist Americans in making oil shale a model of enlightened industrial development.

Thank you Mr. Chairman.

Senator **Hart**. Finally, Dr. House from DOE.

Dr. **House**. Thank you, Senator.

Again, I will attempt to respond to your original question of why the very great range in some of these estimates. And when we came to looking at the socioeconomic impacts after looking at air and water, about which we found a great deal of information, we were even more confused and concerned than we were before.

As you know, there are two types of socioeconomic impacts which need to be addressed, the first sociopsychological in nature, and these are ones which talk about how residents in fact interact with one another: such things as conflict between new and long-term residents, and social problems such as divorce, crime, and the like which have been referred to today.

The second impact is more directly a result of rapid growth. It's the inability of local and State governments to design and fund an infrastructure mechanism which adequately supports the rapidly growing population.

Both of these socioeconomic problems are common elements. Both are related to economic demand placed upon the local public sector. In both cases, up-front capital is required in the geographic area, an area which currently has a minimum infrastructure support capability because of its relatively rural nature.

OUTLINE QUANTITY AND QUALITY OF INFRASTRUCTURE SUPPORT

The population and economic behavior about which we are talking—and this is very important—is not the classic boom-bust situation which is so often occurring in rural areas where single large plants were added to a small community. Rather, if we look at all these projections, it's a situation where we can expect a continuing-growth urbanization with an industry base oriented toward expanding and long-term use of area resources.

None of the studies that we saw talked about growth continuing and sustained over a long period of time. The ultimate concerns in the socioeconomic area are what quantity and quality of infrastructure support should be provided to the growing population and on what schedule. What is the associated cost, and how can this cost be met?

All of the studies that we've looked at and many of those referred to today grew from an impact assessment method developed by Homer Hoyt in the early 1950's. The assessment method used requires estimates of variables related to population growth, employment, and area characteristics. The principal variable for these assessments is a technology mix in the social deployment for oil shale production facilities.

These parameters allow the definition of a labor force required to construct and operate the facilities. Based upon this work force level, indirect employment can also be estimated with this work force of the additional population which represent the workers' families. Once these parameters are estimated, that is, the total population, the local tying in of the cost of the related infrastructure can be estimated. These infrastructure costs can be met through direct revenue, subsidization, taxation, or bond issues.

Let me just briefly, in the interest of time, give you an idea of how wide the range is of many of these studies that have been conducted. The construction labor force for the 400,000-barrel-a-day industry for 1990, from the decade 1980 to 1990 is approximately 5,400 employees. The operating employment over the same period is about 5,700 employees.

Taking this increase in population size, we then begin to look at the range of what's called multipliers, how many more people are brought in because of these workers. These are from studies that looked at just energy industries. They're from a low of 1.24 to as high as 3.8. This is for estimated family size.

INDIRECT EMPLOYMENT FROM OIL SHALE INDUSTRY

Indirect employment, which follows this industry, ranges from a low of 0.4 to a high of 2.0. Based upon the use of this data, if you will permit me to essentially just multiply all the low-range estimates and multiply all the high-range estimates to get a feeling for what the outside boundary can be, the associated 1990 population growth associated with oil shale production in Colorado could be from a low of approximately 55,000 to a high of something like 85,000.

If we look at a cost estimate, which is also given in a range someplace between 3,000 and 6,000, and multiply this again by the low and the high, calculated range in cost for infrastructure could be as low as $100 million to as high as $1 billion for 400,000 barrels per day that decade.

COMPREHENSIVE FRONT-END PLANNING ESSENTIAL

Our expectation as analysts is that these uncertainty ranges will become smaller between now and 1990 for several reasons. First, the oil shale technologies themselves are in the embryonic stage, and we just don't know how many people are going to come in. Second, the various multipliers mentioned above will become more specific as the towns grow in the area and as we learn more about the technologies and the area's reaction as to where people really want to live.

I guess I'll leave the rest of this for later. The major suggestion that we would have for now is that there be—as I heard from my colleagues from the panel here—a great deal of effort done in front-end planning, both with the Federal, State, and local governments and the industry and local populace.

As I mentioned in my last testimony,[1] the Department of Energy has provided, in attempting to help in this area, $2.5 million to local governments and institutions in the oil shale area this fiscal year to do some of this front-end planning.

Thank you.

Senator **HART**. Thank you, Dr. House.

Mayor Schultz?

FEDERAL FINANCIAL ASSISTANCE NEEDED NOW

Mayor **SCHULTZ**. Senator, I know all these fellows here, and they have worked very closely with me for the last 4 years. I want to tell you that I really appreciate the way they have helped Meeker.

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[1] See p. 162.

As for the town, I went to school in Grand Valley and Rifle. I lived in Meeker and Rangely for a number of years. I'll have to speak for all of them, and here's what we need: We need financial assistance to staff up our towns. We need financial assistance for police protection and for roads. We need financial assistance to insure our city employees have new quarters. Then we need money for welfare, housing. And that's not next year; that's this year.

But we've got people coming in, and we're giving them welfare, and we need someplace to put them. We have people living in cars, pickups, and everything else. I'm sure all the rest of the towns here on the western slope have got the same thing. But we need financial assistance now, not next year, And this group has been wonderful to help in every way they can.

Senator HART. Mayor, are these people mostly people that come into town on the basis that there are jobs already available?

Mayor SCHULTZ. Yes, that's right.

Senator HART. They're just showing up and waiting for jobs, and there's no jobs. The coal industry is soft, and the oil shale hasn't gotten geared up yet. We're in a very bad situation in Meeker. And I know Ranelgy, is because I talked to Peggy every day. And Rifle, they come here first, so I know they have a bunch. And Grand Valley.

I feel sorry for them. I went to school back there in 1926, and there's a lot of changes. But I feel sorry for all of them. I don't know how we're going to meet this mass of people that's coming in, because we have to work so fast. And that's why we need the lean time.

Senator HART. Thank you for your comments.

Commissioner Cerise?

CUT REDTAPE BINDING AVAILABLE FEDERAL FUNDS

Commissioner CERISE. I, too, work with these people and have worked with them for a long time. I think that we are going to be facing a lot of problems and there are Federal funds available. The Department of Energy has planning money. But, you know, you can plan. But if you can't go any further, what good does it do you?

We have the 601 funds that are matching funds. Where do you come up with the 25 percent? I think we need to cut a lot of redtape. If we're going to be able to survive the onslaught that we could have here, we need to cut some of this redtape.

And, also, if there is any additional lease money, it should somehow come straight to the counties and not through the JBC's where we have to go over there and beg, and they play politics with that money.

I really feel we're going to need a lot of help. There's some money available, but it only takes you so far, and from there on, you're on your own. We don't have the capabilities to go from there on. I think that Mr. McDermott made a statement that there would be $17 million that would go into the oil shale trust fund, and I think he probably meant into the impact fund and not the oil shale trust fund.

Mr. McDERMOTT. No. What I meant by that is, that's the result, and that's 50 percent of the total payment. The total payment would be $34 million, but half of that would flow into the impact fund; yes.

Commissioner **Cerise**. That's really all I have to say, that we need to cut a lot of the redtape so this money is more readily available to us.

Senator **Hart**. Thank you, Commissioner.

Senator Soash?

ESTIMATED SIZE OF OIL SHALE INDUSTRY IN THE YEAR 2000

Senator **Soash**. Thank you, Senator.

I totally agree with the least part of what Commissioner Cerise said, that I think we need to make some changes in the allocation for mineral leasing money. The upward limit we've had on those allocations haven't been changed for 20 years now and are unrealistic, and we certainly need to change that. Quite frankly, the more directly we can return this money to local government, the more beneficial it is.

My colleague from Meeker and I don't always agree on this, but I don't like the aspect of going on bended knee before the Joint Budget Committee. At the same time, I'm reticent to see local affairs have the amount of control that they have now in allocating some of the impact money. And I think there may be some kind of middle ground where we could remedy both of those.

Mr. McDermott, I want to ask you some questions. In RMOGA in your discussions, have you come up with what you think are reasonable estimates of the size of the oil shale industry, say, up to the the year 2000?

Mr. **McDermott**. Well, I think that the industry has said that it looks like certainly the President's goal of the 400,000 barrels is attainable.

Senator **Soash**. By the year 2000?

Mr. **McDermott**. That's right.

Senator **Hart**. That goal is 1990.

Mr. **McDermott**. Yes. I'm sorry—by 1990.

SIZE OF OIL SHALE INDUSTRY DICTATED BY PEOPLE ISSUES

Senator **Soash**. What would you estimate it would be by the year 2000?

Mr. **McDermott**. I would say that's going to be limited by our ability to get the people in here and possibly in the neighborhood of a million and a half.

Senator **Soash**. I would think that and also our ability to provide water from whatever source to that industry as it rose above the capability to provide water today.

Mr. **McDermott**. I think the point I make is you can buy water. I don't think you can buy people. If you don't have a quality situation, it doesn't make any difference. But water will flow toward money.

Senator **Soash**. The point I was going to make is that I think we're going to see substantial——

Senator **Hart**. That's what a lot of people are afraid of.

Senator **Soash**. We're going to see some subsantial activity in the oil shale industry. But I have some real doubts as to whether we'll ever see an 8 million-barrel-a-day industry or anything even approaching that considering the natural constraints of the water availability and some of the other problems that we have surrounding it.

And I'm not so sure that we ought to get too hung up on the numbers that are associated with that size of an industry, but rather we ought to concentrate on what's realistic and work toward providing the infrastructure we need to accommodate that size of an industry.

Senator HART. Representative Theos?

LAND AVAILABILITY

Representative THEOS. Thank you, Senator. In defense of the Colorado General Assembly and the JBC, I'll have everybody know that we're real responsive over there, and we're kind of conservative. And if there's any politics being played, it's been played by the county commissioners and not by the general assembly. They're the ones that send in their priority, and we have to just fund for them. I didn't see any of them really waste their knees, getting on their hands and knees, yet. They just come over there and ask for the money and we dole it out to them.

But you never can get enough money to these county commissioners. I guess Tim and everybody on the panel, you're talking about money is the only thing. Money, you can get more money. They manufacture it in Washington. They just turn a crank. But you can't make any more land. And land is going to be a problem. About 80 percent of this western Colorado is Federal land and only about 20 percent is private land.

If you're going to grow a city the size of Grand Junction or Glenwood every year, you haven't got any land. We have to do something. I'm not going to discuss "sage brush revolution" here today; that comes later.

But, anyway, this is where we're hurting is on land in this country. Where are we going to put all these people when we get them? And I can see the concerns of the ski industry. They're getting impacted. And I guess that's my statement.

Now, my question is: Steve, how far do you go with this impact assessment fund? You heard what the ski industry said. Do you think and feel that they got enough criteria or justification to ask for impact funds on up this line?

Mr. SCHMITZ. I think it would require changes in the legislation, Representative Theos. Right now the legislation is written very specifically for the two funds we have, both of which are called local government energy impact funds—or mineral, of course, because molybdenum does pay a portion of the severence tax.

Consequently, our criteria—to stay straight with legislative intent on this matter, which I know we are—is to look at the mineral or the extractive industries as being primary fomenters and, the communities involved such as the ski industry, as being ineligible recipients at this point.

Representative THEOS. May I ask one more short one? We were talking about water a while ago, and a lot of concern was given to water for agriculture. But if you move that many people in here, whatever you project, you won't have to worry about getting water for agriculture. There won't be any agriculture. I, for one—you talk about the senior citizens being impacted. The sheepherders and cowboys are, too. We can't operate under the conditions of that many people moving in, especially when they bring four or five dogs with them. And this is what the oil companies will have to see, the quality of people coming in. I hope they tell them to leave their dogs at home when they come to work for you.

Senator HART. That's a problem I hadn't thought of.

LOCAL GOVERNMENT ADMINISTRATION OF IMPACT ASSESSMENT FUNDS

Commissioner SCHULTZ. I would have to make a couple of comments back. I have to agree with Representative Theos on the land problem. And I think we were trying to address that as saying that we need the Federal Government and the State government and the local government to get together and talk about the whole spectrum of things, not only how many schools we need but where do we need dams located, how do we get water developed, how do we get some land from the BLM for housing developments, this type of thing.

But I think one of the hardest things that is for a locally elected official to accept is that it seems that the higher we go in government, the less responsible those higher officials think the ones immediately below them are. And I think that's the problem we have today. The Federal Government doesn't trust the State government, and the State government doesn't trust the local government.

And I, for one, feel the local government is the most responsive to the people. We're there to face the people every day. They can replace us if we're not doing a good job of handling the money. And I think it's very important that that's not only recognized at the State level but particularly important that that's recognized at the Federal level. We're the people that have to live with the problem every day. We're the ones that have to live out here. And it has to be recognized by Senators and Representatives from all across the country that they need to give local people the tools to deal with the problems. And if we do that, we can solve the problems.

Senator HART. Well, Commissioner, there's only one problem with that and that's called State government. The impact assistance bill was going to provide loans and loan guarantees directly to counties, and it wouldn't pass because the Governors opposed it.

Commissioner SCHULTZ. Yes, I realize that.

Senator HART. There you are. What you're saying today is an exercise in creative federalism.

Representative Edmonds?

Representative EDMONDS. How many dogs do you own, Bill?

Mr. MCDERMOTT. I own one.

Senator HART. One per oil company.

STATE SHARE OF ROYALTIES FROM FEDERAL TRACTS

Representative EDMONDS. I'd like to focus just a minute on the problem that you spoke of, Mr. McDermott, on the prolonged startup versus the immediate need. You spoke of Oxy's generating $17 million. And were you talking about mineral severance tax moneys, or were you talking about royalties?

Mr. MCDERMOTT. I was talking about the share of the royalties off Federal tracts that will flow to the States, the 50 percent.

Representative Edmonds. The 50 percent that will flow back to Colorado rather than Rio Blanco County?

Mr. McDermott. Right.

Representative Edmonds. Of that $17 million then, what year would you be generating that amount of money?

Mr. McDermott. That would be 1990. That's under the full-scale operation, and that's in 1980 dollars.

Representative Edmonds. But not tomorrow, certainly; 1990 is what you're looking at?

Mr. McDermott. Right.

PROJECTED REVENUE FROM MINERAL SEVERANCE TAX

Representative Edmonds. In that Peat, Marwick, & Mitchell study that was done for RMOGA, that certainly sounds impressive when we're talking about $6 billion being generated in 25 years. Do you have any statistics on the 400,000-barrel-per-day level? How much money would be generated to the taxing entities? And, particularly, when or how much would be generated for the mineral severance tax?

Mr. McDermott. The study was just reviewed in the draft form this week, and I don't have those details with me. But it's the intent of my committee to meet with the local and county people in the tricounty area here and to discuss that whole study with them. And we're in the process right now of setting up some dates to do that. So that type of information is explicitly available.

OIL SHALE TRUST FUND

Representative Edmonds. We at the State level would be particularly in the mineral severance tax grain because of the exemptions of the early stages and what would be generated.

In terms of how much money we now have, I know Senator Hart said that one difficulty he has with his colleagues is they always come back and say, "What about that magnificent oil shale trust fund?" What is that now, about $55 million—at the end of the current fiscal year, what will that be? About $55 million?

Mr. Schmitz. We estimate about $55 million in the fund available for appropriation July 1, 1981.

Representative Edmonds. And it might be informative for the Senator to know what the counties are going to try to do with that $55 million.

Tim, would you explain that, please.

Commissioner Schultz. I would be glad to. To date, we have gone annually before the Joint Budget Committee and the legislature asking for those funds. What that has done is created a vehicle. It's worked—I don't want to criticize it and say it hasn't worked. It's worked well, but you get the school districts, the counties, the cities all coming in at one time saying, "We need this whole school paid for," and, "We need this whole new municipal building," and, "We need this new sewer plant."

And if you'll look at the figures that Steve threw out as the total dollars we need, that $55 million is just a tiny, tiny portion of that. We feel that the best way to utilize that money is to look at the projects we're going to need over the next 5 years. Then take that money and match it up against those projects. So a school may not be able to be totally funded. It may only be 50 to 60 percent of the funds it needs. But they have to go somewhere else to get the balance.

We can get many more projects funded, get our communities in much better shape, if we're able to do some long-range planning with it rather than every year have everybody come in and try to get a total project funded.

In order to do this under Colorado State law, we're going in and asking the legislature to appropriate the entire oil shale trust fund this year based upon an expenditure plan arrived at by each county. In Rio Blanco County, that would be over a 5-year period. We're asking them to place that money into the department of local affairs to give back to us.

As the years progress, if we have a change in our priorities, which is very likely, and 5 years from now we missed a project or one is not needed, we would then go back through the Joint Budget Committee to the legislature to show them that the new project that we want to spend the money on in place of an old project is a very viable and realistic one, and they would then have to give their approval to change the way that money will be spent.

The reason to go about it this way to ask for it all appropriated in 1 year is under State law that one legislature cannot commit the next year's legislature for how money should be spent. So we're asking for the whole amount to be set aside based upon the Rio Blanco County 5-year plan.

Representative EDMONDS. So, to assume if the legislature followed that request, that money would be obligated for the next 3 to 5 years?

Commissioner SCHULTZ. Yes; to each county for capital improvements.

LOCAL GOVERNMENT'S SHARE OF MINERAL SEVERANCE TAX REVENUE

Representative EDMONDS. Just to put the final picture in perspective, the oil shale trust fund would be gone, at least the bonus bid money, until the royalties started flowing in, and you wouldn't have any money in the oil shale trust fund? Then the other State fund would be the mineral severance tax.

Steve, right now last year after $25 million, it came from that, how much was for local government? About $7 million?

Mr. SCHMITZ. Approximately.

Representative EDMONDS. So we've got about $7 million to deal with them for local governments. That would be the major amount of money.

Mr. SCHMITZ. Well, then an additional $3 or $4 million in the mineral leasing money as well.

Representative EDMONDS. OK. $3 or $4 million in mineral leasing money; $11 million is not quite the large estimate we're talking about later down the road. And I think that's important to emphasize, otherwise we're liable not to—again and again it seems like we're going to be preparing for a flood after it's rained.

FINANCIAL RESOURCES EXPECTED TO EBB AND FLOW

Mr. SCHMITZ. Also, it's important to know that in many instances we're talking about an ebb and flow of financial resources, because the decade of the 1980's is going to be a particularly difficult one. For one thing, the impact assistance fund will grow substantially next year because of the change in the law, but we're anticipating a very severe drop from about 30 million barrels a day in oil production to about 14 million barrels a day throughout the course of the decade, ending at 14 million. And that revenue itself will just not be available.

So projections are very odd at this point in time. We will have to have a substantial increase in coal in order to continue to fuel the money that's available which would normally be available from oil and gas. And it's 14,000 barrels daily, not 14 million, excuse me.

Senator HART. Thank you.

Senator SOASH. On the other hand, isn't it true, Steve, that the higher price for gold and silver as appears now likely, there will be substantial severance tax arrived at in precious minerals we didn't anticipate?

Mr. SCHMITZ. That's exactly right. There's an indication that because of the high price primarily of gold and silver, it will drop back down to a more reasonable level, and it will produce revenues. I believe that it will be—this year we're estimating about $4 million in severance taxes from mineral, county, and other places. That would add an additional $2 million I think.

Senator HART. I wish to thank this panel very much. Thank you for your testimony.

Now, Mr. Slick, you're welcome to come back if you would. The floor is yours briefly to comment on any of the testimony you've heard or correct the record or make a comment of any kind.

Mr. SLICK. I will keep it brief, Senator. I am not going to get into a lot of details or debate the numbers. I would just make a couple of quick summary kind of comments to try to come back and put where I stand in prospective.

We have tried to share with western Colorado and with many around the country, for that matter, the planning studies that we've done within Exxon. These studies are not just esoteric exercises but rather are studies on which we have made substantial capital commitments in the synthetic fuels industry. The most visible one in this part of the country is the $400 million that we've spent to acquire an interest in the Colony project.

We have efforts underway to exchange properties that we own in the Piceance basin for consolidated Federal tract for 100-percent Exxon oil shale operation. We're looking at a $3 billion synthetic gas operation in Texas. We're serious about what we're talking about.

We've tried to lay out what the potential is. What this country realizes out of that potential is going to be dependent on decisions made by many, many people, the least of which is Exxon.

PROBLEMS SURROUNDING OIL SHALE INDUSTRY NOT INSURMOUNTABLE

We've talked today about a number of problem areas: water, air, socioeconomic impacts. Our assessment says that there's enough water to get to an 8-million-barrel-a-day industry. Some of it is here in Colorado, and some of it will have to be brought in to get that far. Where that break point is, time will only tell. It's physically possible, it's economically possible, and it's technically possible, but we don't know whether it's politically possible.

We've talked about air today, and Mr. Thoem made the observation that it's dangerous to play the numbers games because you can get misled if you're not careful. I suspect that if any one of us had thought about how many miles it is to the moon or how fast that rocket was going to go, we'd all be scared to death. But the guys got there and walked around up there.

The control technology to which Mr. Thoem made reference to: he said 99.6 percent recovery, and there's not much room to go, and I agree, there isn't. But from 99.6 to 99.8, you can look at that as only two-tenths improvement, or you can look at it as you cut the distance in half, or you can look at it that it's permitted you to double the size of an industry that's feasible. So I think we need to avoid getting too hung up on the specific numbers and try to figure out where we're going to go.

On air, the facts of the matter are that we have in existence a legislative and regulatory framework within which we are living and an oil shale industry if it is developed will develop in compliance with that framework.

The socioeconomic impacts are probably the most difficult for the simple reason that they're the ones that deal directly with people. People questions are always the most difficult and, in my mind, probably always the most important. Some of the numbers are large. Mr. Schultz said something about $21 billion. I will not debate that number; that's a big number. If you put it in the context of the total amount of money that would be involved investmentwise in that kind of an industry, a trillion and a half dollars, that $21 billion then takes on a different prospective.

EVALUATE EXXON'S INTENTIONS BY EXAMINING PAST PERFORMANCE

Exxon intends to become a citizen of the western slope in the full and best sense of that term of citizenship. Our employees are going to be asked to live here, and we don't intend to ask them to live in a place that we don't think is an appropriate or suitable place to live. We're not trying to see what we can do wrong to this country; we're trying to see what we can make happen in a constructive way.

Reference was made to Rock Springs. And I would say to you that if it's going to go like Rock Springs, we're not going to be any part of it. Rock Springs is totally unacceptable, and we're not going to replicate that if Exxon has anything to say about it.

Senator Soash made an observation, and it's one which I think he should make. He said he took my comments with a grain of salt. If I were in his position, I would too. In fact I would suggest to everybody in this room that insofar as my comments are concerned, you can take them with a grain of salt if you care to. Because I ask you not to judge Exxon on the basis of what I've said here today. I ask you to look back a few months down the road or a few years down the road and judge Exxon on what we've done here. We're willing to stand on the judgment of what our actions have been, what our performance has been.

I said earlier, and I say it again, Senator, I think one of the most important points of getting this process going is to get the public dialogue going, get the discussion going. I again commend you for the efforts to do that in Denver and here today. You've been most gracious. The panel and the audience have been most gracious and patient and graceful to all of us, and I appreciate this very much.

NATION FACES UNPRECEDENTED TESTS IN THIS DECADE

Senator HART. Thank you very much. Mr. Slick, let me just repeat a theme. Exxon is not on trial. I think the United States of America is on trial. I think this country is going to be tested in the 1980's in ways that we've never been tested before since World War II and the Depression, the Civil War. The tests are going to be whether we can use less and maintain our standards of living, and I think we can. The tests will be whether we can cure ourselves of an addition for oil and become energy independent, and I think we can. The tests are whether we can do that and not destroy our way of life or our public health and safety in the process, and I think we can. And the tests are whether all levels of government can assume responsibility for the effects of those dramatic transitions in the American system and way of life in a decade and cooperatively work to make that transition acceptable, and I think we can. It is going to take understanding, and it is going to take a lot of cooperation.

For those who consistently say, "Get the Federal Government out of our lives," I think what we've heard here today is the Federal Government can't get out of our lives on an issue like this. These are Federal resources owned by the people of the United States of America. The disposition of those resources is a responsibility that the Government owes to the people of the United States of America.

And for better or worse through accidents of faith or geology or devine choice, the State of Colorado is going to be right in the middle of all of that. And this State is going to be tested in the 1980's in ways that we haven't been tested in 100 years, whether we can become in a decade an industrial State, because we're going to be, whether the sheep herd is going to be maintained or the skiing can be maintained, whether Rifle and Grand Junction way of life can be maintained. Not all of those things are going to be able to be done, but the tasks of all of us, particularly those of us in elected positions, is to do our best. And it's going to require a great deal of understanding and character and, as you say, shared information.

I want to thank all of those, including yourself, who have participated in that today and in July and my colleagues on this panel who have enormous responsibilities on a day-to-day basis. Thank you all very much.

The hearing is adjourned.

[Whereupon, at 2:20 p.m., the hearing in the above-entitled matter was adjourned.]

EXXON COMPANY, U.S.A.'s

Energy Outlook 1980-2000

December 1979

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Introduction

At Exxon, assessments of the national energy environment ten, twenty, or more years into the future are an essential element in making long-term plans and investment decisions. This booklet, which updates the December 1978 Outlook, summarizes Exxon's assessment of the period 1980-2000. It reflects the impact of economic, environmental, technical, and governmental factors, including recent legislation affecting energy.

The U.S. energy projections presented in the following pages are not intended to be firm forecasts. This Outlook represents a "snapshot" incorporating our best judgment at a particular point in time of the many factors affecting the nation's energy future. As these factors and our perception of them change, the details of the Outlook may change. It is hoped, however, that this material will help clarify basic issues and provide a useful frame of reference for evaluating other perspectives on the nation's energy future.

Most graphs are scaled in millions of barrels per day of oil equivalent, a measurement that can be conveniently applied to all forms of energy, based on their heat content relative to that of oil (5.55 million BTUs = 1 barrel of oil).

Basic Assumptions

The assessments in Exxon's Energy Outlook are tied closely to specific assumptions about future circumstances affecting world and U.S. energy supply and demand. Any significant variation from these bases could considerably modify our projections. We present here certain of our fundamental assumptions.

Government Energy Policy Government energy policy will permit economic growth and establish a new balance between energy, economic, and environmental goals. And, as discussed later, U.S. policy will not limit imports below requirements. Natural gas prices will be governed by the Natural Gas Policy Act of 1978. Domestic crude prices are assumed to achieve parity with world prices by October 1981, in accordance with the Administration's crude price decontrol plan. In conjunction with decontrol, an excise tax will be imposed on crude.

The Economy There will be long-term economic growth leading toward full employment. The increasing costs of meeting social goals, in addition to higher energy costs (which will cause investments to be made to save energy), will divert a greater amount of capital from investment in output-producing equipment, resulting in lower than historic gains in labor productivity. This factor, along with projected slower growth rates in the labor force, will result in slower long-term growth in GNP, on the average of just under 2.7% annually through 2000, compared with 4.1% over the 1960-73 period.

The Environment Environmental goals will be achieved at a rate compatible with economic growth. There will continue to be some accommodation of compliance deadlines when the alternative is to shut down major existing facilities. Moreover, environmental policies will not prohibit the construction of major new facilities inherent in the projections of future economic and energy growth.

Oil Imports To supply the needs of the U.S., increasing imports from nations affiliated with the Organization of Petroleum Exporting Countries (OPEC) will be required. It is assumed that over the long term, world oil prices will increase at a rate greater than world inflation and that international energy trade will not be hampered by economic instability or lack of international cooperation.

While continued growth in total free world oil supplies is projected through the 1980s, a plateau in production appears likely around the turn of the century.

U.S. Energy Demand by Consuming Sector

U.S. Energy Demand by Consuming Sector
(million barrels/day oil equivalent)

	1960	1980	1990	2000
Nonenergy	1.9	3.2	3.7	4.2
Industrial	8.0	12.6	14.8	18.6
Transportation	5.4	9.9	9.4	10.0
Residential/Commercial	6.6	13.0	15.1	17.5
TOTAL	21.9	38.7	43.0	50.3

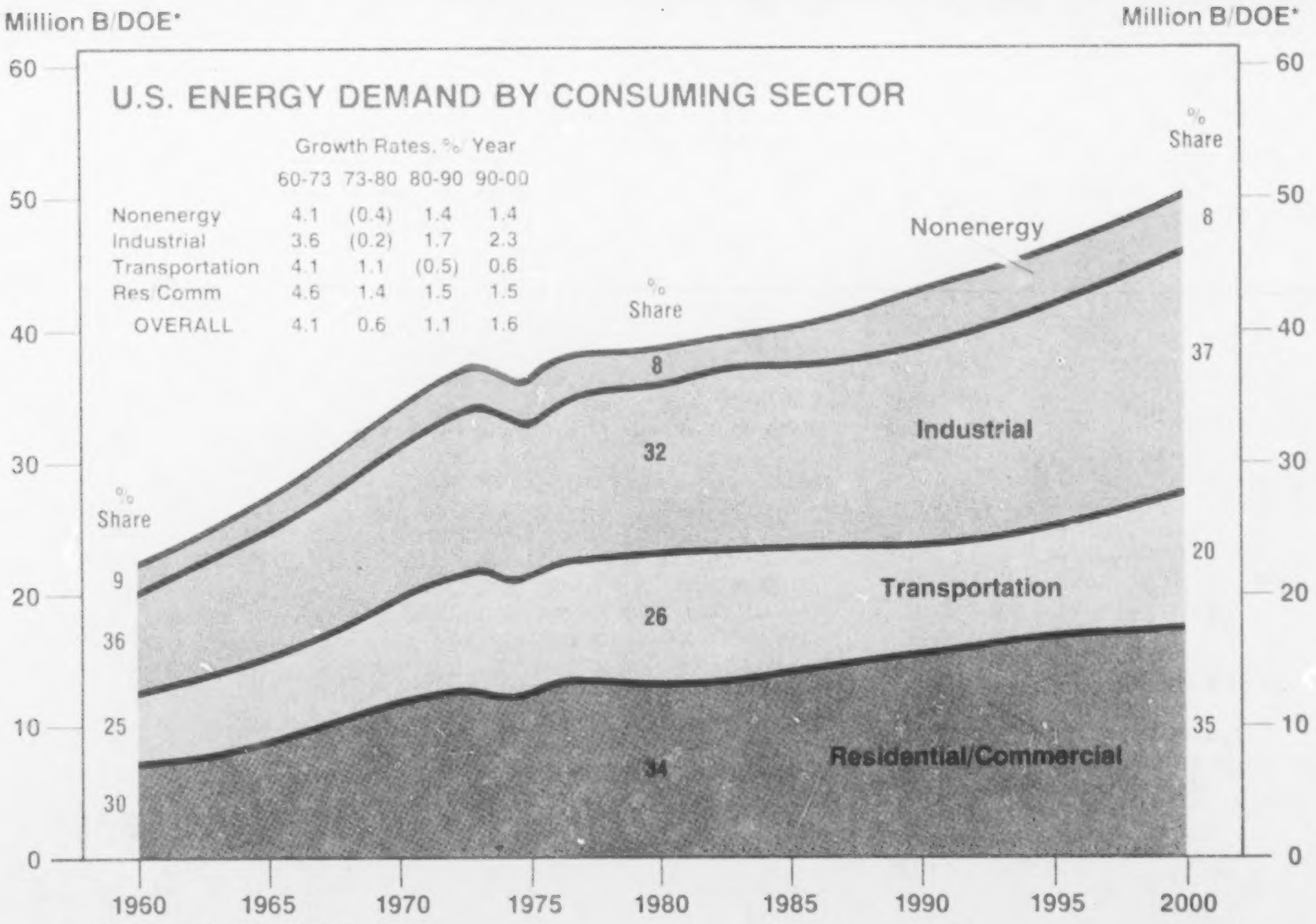
Total U.S. energy demand is projected to increase from 38.7 million barrels per day oil equivalent in 1980 to 50.3 million barrels per day in the year 2000. Energy demand growth will average 1.1% in the years 1980-90, versus 4.1% a year during the 1960-73 period. The growth rate accelerates to 1.6% in the 1990-2000 period, principally because of energy required for synthetic fuels production and a decline in the rate of efficiency improvement. For example, in the transportation sector, significant improvement in passenger car mileage through 1985 will essentially be accomplished with existing technology. Past 1985, any significant mileage improvement will depend primarily on technological evolution. Similar profiles occur in the other consuming sectors.

Nonenergy Consumers in the nonenergy sector use oil, gas, and metallurgical coal as feedstock or raw material, rather than as fuel, in the manufacture of such products as petrochemicals, asphalt, lubricants, and steel. The demand growth rate in this sector will be less than the historic rate due to slower economic growth and higher energy-derived raw material costs.

Industrial This sector, which includes all mining and manufacturing industries, consumes gas, oil, coal, and electricity. Although gas has historically been the predominant industrial fuel, it will decline from about 54% of sector demand in 1980 to 44% in 1990 and only 26% by 2000. Coal's share increases significantly, from 8% of sector demand in 1980 to 46% by 2000. Oil's share drops by nearly half, from 22% in 1980 to 12% in 2000, while electricity remains in the 16%-18% range for the Outlook period.

Transportation Transportation is almost entirely dependent on oil and will account for about half of total oil consumed through the year 2000. Energy demand in this sector will decline through 1990, then grow at an average annual rate of only 0.6% to the end of the century. Because of increasing mileage efficiency, motor gasoline demand for automobiles and light trucks is expected to be about 7.1 million barrels per day in the 1980-81 period and decline to 5.5 million barrels per day by 1990 and 4.5 million barrels per day by 2000.

Residential/Commercial This sector includes private and public buildings, such as homes, stores, office buildings, hospitals, and schools. Demand growth is expected to decline from that of the pre-Arab embargo period, due primarily to more efficient energy use and a lower rate of household formation. Demand growth will be met primarily by electricity and gas. Gas is expected to be available for these high priority uses.



U.S. ENERGY DEMAND BY CONSUMING SECTOR

	Growth Rates, %/Year			
	60-73	73-80	80-90	90-00
Nonenergy	4.1	(0.4)	1.4	1.4
Industrial	3.6	(0.2)	1.7	2.3
Transportation	4.1	1.1	(0.5)	0.6
Res/Comm	4.6	1.4	1.5	1.5
OVERALL	4.1	0.6	1.1	1.6

*Million Barrels/Day Oil Equivalent

U.S. Energy Conservation

Energy consumption in 1980 is estimated to be reduced by the equivalent of about 6 million barrels of oil per day, compared with the demand level that would have been expected if energy prices and consumption patterns were assumed to follow the trends of the 13-year period (1960-72) immediately prior to the 1973 Arab embargo. These savings are projected to reach 16 million barrels a day by 1990, and 27 million barrels by 2000.

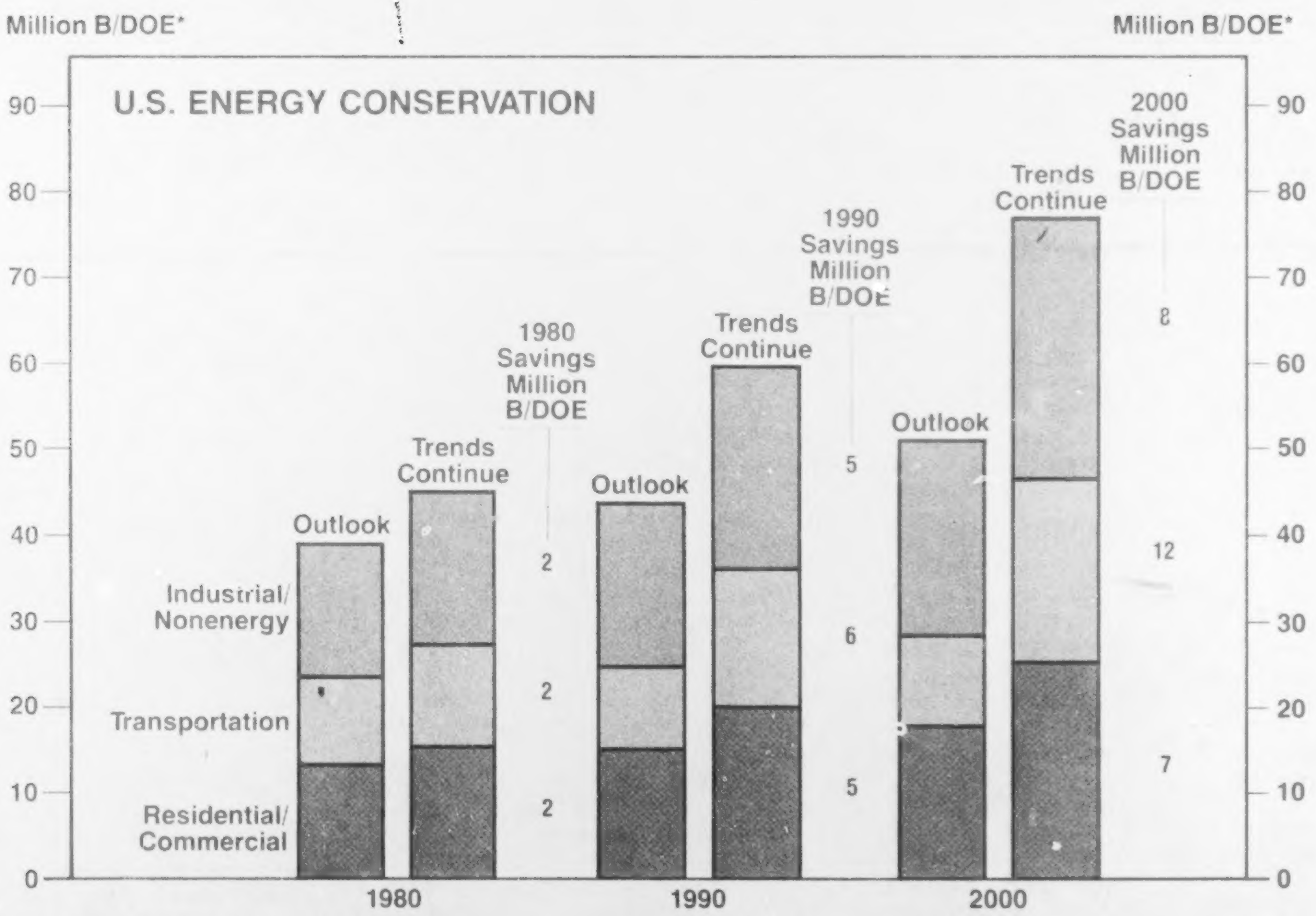
Savings in the **Industrial/Nonenergy** sectors will come from better energy management, the retrofitting of industrial equipment, and new processes developed because of higher energy costs. By the year 2000, demand in these sectors is projected to be reduced by 25%, compared with the 1960-72 trends.

Demand in the **Transportation** sector, where personal automobiles account for more than one-half of the sector's energy use, is expected to be reduced 55% by 2000, compared with the 1960-72 trends. Total motor gasoline demand, which peaked in 1978 at 7.4 million barrels a day, will decline steadily through the Outlook period. This is largely a reflection of increased automobile efficiency. By law, new car gasoline mileage is to improve to 27.5 miles per gallon by 1985. This Outlook is based on the assumption that actual new car road gasoline mileage will reach 36.5 mpg by 2000. This further efficiency improvement is anticipated from reduced automobile weight and the increased use of diesel fuel. Diesel automobiles are projected to make up 14% of new car sales in 1990 and 25% in 2000. If the trends in weight reduction and technological change continue, the average new car weight in 2000 will be reduced to about 1,700 pounds, compared with about 3,100 pounds in 1979.

In the **Residential/Commercial** sector, voluntary steps can contribute significantly to reduced energy use. Energy savings are expected to result from such measures as adjusted thermostat settings, reduced water temperatures, improved building insulation, selection of more energy-efficient appliances, and retrofitting of existing homes. For example, expanded use of heat pumps will make a significant contribution. Demand reduction in this sector is expected to reach 29% by 2000.

U.S. Energy Conservation
Projected Demand Reduction by Sector (%)

	1980	1990	2000
Industrial/Nonenergy	12	21	25
Transportation	17	39	55
Residential/Commercial	13	25	29
OVERALL	13	27	35



*Million Barrels/Day Oil Equivalent

U.S. Energy Supply

Energy conservation is an important goal, but it alone cannot solve the nation's energy problems. If the U.S. is to reduce its dependence on foreign oil imports, aggressive development of all U.S. energy resources must be carried out in conjunction with energy conservation.

Oil will remain the primary source of energy for the U.S. until the end of the century, when coal will have an equivalent share of total supply. Nuclear's share also advances, but the use of natural gas declines steadily over the Outlook period.

U.S. Energy Supply
(million barrels/day oil equivalent)

	1960	1980	1990	2000
Hydro, Geo & Solar	0.8	1.5	1.8	2.5
Nuclear	--	1.7	4.0	6.3
Coal	4.8	7.5	11.3	16.4
Gas	6.5	10.2	9.5	8.7
Oil	9.8	17.8	16.4	16.4
TOTAL	21.9	38.7	43.0	50.3

Hydro, Geothermal, and Solar Hydro, geothermal, and solar power combined are estimated to supply 4%-5% of total U.S. energy requirements in the 1980-2000 period. The growth potential for hydro and geothermal is limited because of site availability. Solar's most economic application through 1990 — water heating — will be limited by high initial costs and practical considerations as to how fast it can be brought into wide use. Achieving solar's potential will require technological improvements to reduce current costs.

Nuclear Nuclear energy is confined to electric utility use. Although its development continues to be marked by construction, regulatory, and siting delays, nuclear's share of total energy supply is expected to grow from 5% in 1980 to 9% in 1990 and 13% by 2000.

Coal U.S. coal production is expected to increase from 734 million tons in 1980 to nearly 1.3 billion tons by 1990 and 2.2 billion tons by 2000.

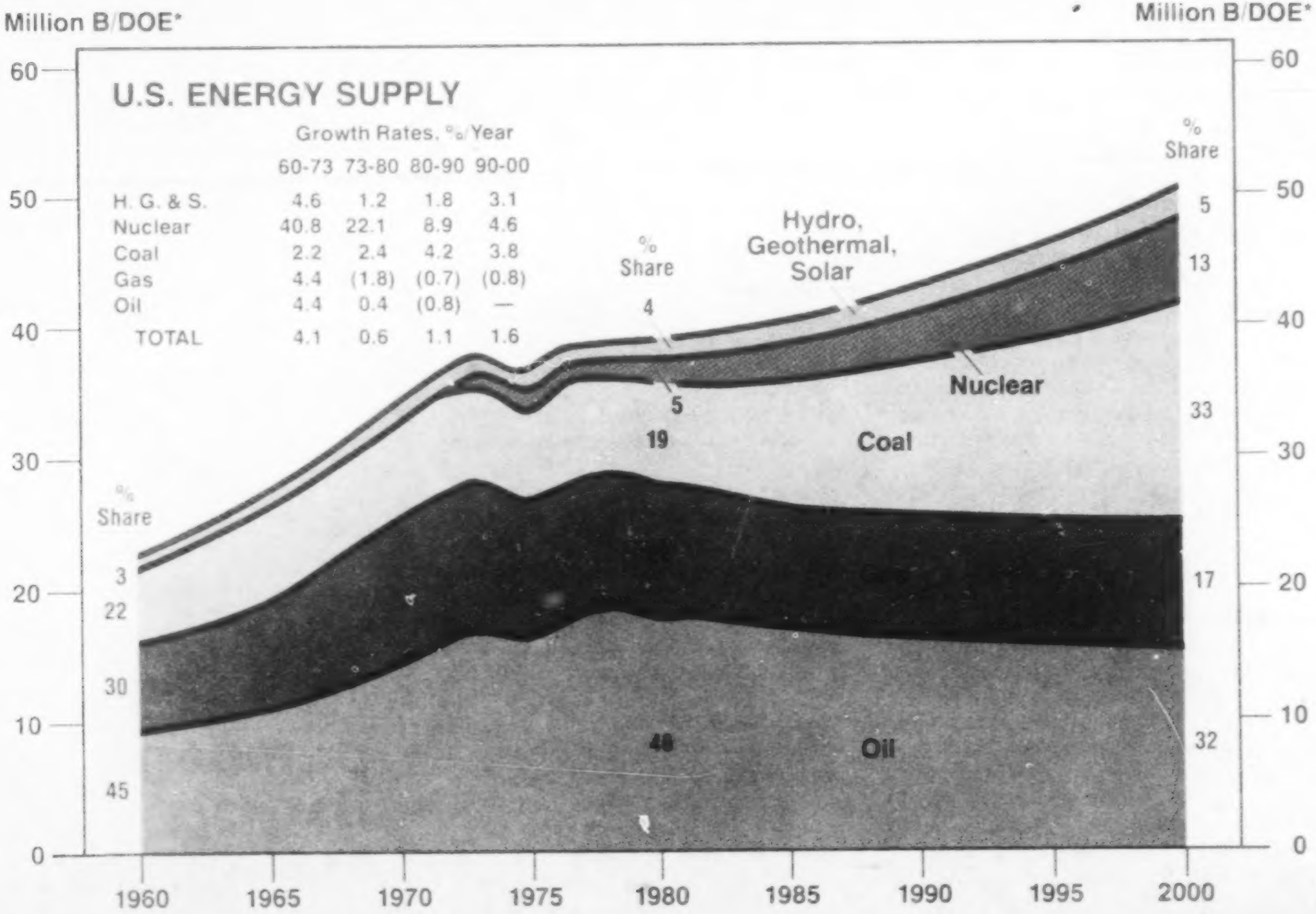
U.S. coal resources, as well as the capability to develop them, are more than adequate to meet projected demand, assuming reasonable coal mining regulations. Coal used to make synthetic oil and gas accounts for an increasingly large portion of U.S. production, growing from 6 million tons in 1985 to 160 million tons in 1990 and to 645 million tons in 2000.

Gas The absolute volume of natural gas consumed, as well as its share of total energy demand, will decline steadily over the Outlook period.

Domestic conventional gas supplies are expected to be supplemented from other sources, including synthetic gas manufactured from coal, imported liquefied natural gas (LNG), and overland gas imports. While each of these sources is potentially important in its own right for the future, their magnitude does not change the outlook for declining gas supply and use.

Oil Oil's share of total energy supply declines from 46% in 1980 to 38% in 1990 and 32% in 2000. Although oil's share of total energy supply declines, the absolute volume of oil consumed will drop only slightly by 1990 and will remain constant through the end of the century. Domestically produced oil from conventional sources will be supplemented by imports and synthetic oil from coal and shale.

New Energy Sources Extensive research and development efforts are under way to develop new, "inexhaustible" energy technologies, such as nuclear fusion. However, these potentially important energy sources are not expected to contribute significantly to total energy supply during the Outlook period.



U.S. ENERGY SUPPLY

	Growth Rates, %/Year			
	60-73	73-80	80-90	90-00
H. G. & S.	4.6	1.2	1.8	3.1
Nuclear	40.8	22.1	8.9	4.6
Coal	2.2	2.4	4.2	3.8
Gas	4.4	(1.8)	(0.7)	(0.8)
Oil	4.4	0.4	(0.8)	—
TOTAL	4.1	0.6	1.1	1.6

*Million Barrels/Day Oil Equivalent

U.S. Electric Utility Demand

U.S. Electric Utility Fuels

	1980	1985	1990	2000
Nuclear Capacity (1,000 MW)	68.0	123.0	146.0	211.0
Coal (million short tons/yr)	542	695	802	970
Oil (million barrels/day)	1.4	0.8	0.4	0.3
Gas * (trillion cubic feet/yr)	2.6	1.6	1.8	0.6
Other (million barrels/day oil equivalent)	1.5	1.6	1.8	2.5

Electricity currently accounts for about 9% of total energy demand on an as-consumed basis. Its share grows modestly, to about 10.6% by 1990 and slightly more than 11% by 2000. Nevertheless, on an input basis, today's electric utilities require about 30% of the total energy consumed in this country, growing to 36% by 2000.

Demand for electricity is expected to grow at less than half the pre-embargo rate through the end of the century.

The potential growth in **Hydro** and **Geothermal** is relatively small and limited by their natural occurrence. Combined, Hydro and Geothermal will meet about 13% of utility demand throughout the Outlook period.

Coal is projected to continue as the major utility fuel, supplying about half of utility fuel demand through the Outlook period. **Gas** consumption by utilities will decline due to decreasing supply, the low priority of utilities as gas consumers, and the impact of legislation limiting the use of natural gas by utilities. **Oil's** share declines sharply, from 12% of utility demand in 1980 to less than 2% by the end of the century.

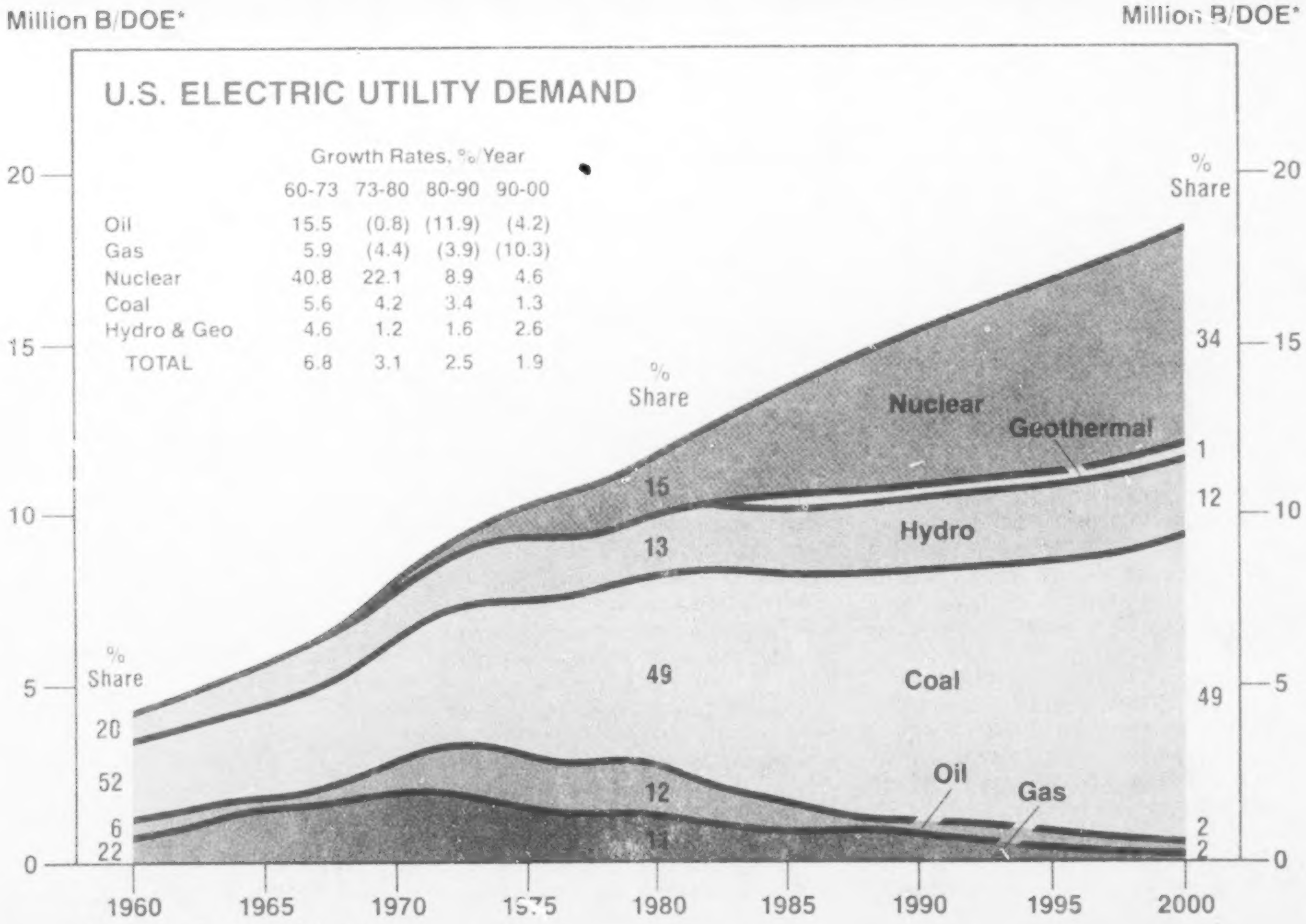
By 2000, **Nuclear** is projected to supply 34% of U.S. electric utility demand, compared with 15% in 1980 and 27% in 1990. Licensing delays, along with environmental and siting problems, have continued to retard the growth of nuclear capacity. Since 1975, the ordering rate for new nuclear plants has been substantially below the rate of the early 1970s. In 1978, only two new plants were placed on order.

The nuclear reactor accident at Three Mile Island, Pennsylvania, in March 1979 is not assumed to have a long-term impact on the rate of development of nuclear power. It already takes 11 to 12 years to design, license, and construct a nuclear power plant.

The projections in this Outlook require that approximately 8 thousand megawatts of nuclear capacity a year be brought on line; the reactors projected to be in operation through 1990 are currently either under construction or on order.

The present downturn in new plant orders will directly affect the availability of nuclear power in the 1990s; however, these projections assume an increase in the nuclear reactor ordering rate in the early 1980s to meet electric demand in the late 1990s.

Approximately 95% of known economically recoverable U.S. uranium reserves are located in sedimentary basins in the Western U.S. and the potential for additional discoveries is believed to be large. Much of this area has yet to be adequately explored. If these reserves are developed in a timely fashion, uranium imports should not be significant in the Outlook period.



U.S. ELECTRIC UTILITY DEMAND

Growth Rates, %/Year

	60-73	73-80	80-90	90-00
Oil	15.5	(0.8)	(11.9)	(4.2)
Gas	5.9	(4.4)	(3.9)	(10.3)
Nuclear	40.8	22.1	8.9	4.6
Coal	5.6	4.2	3.4	1.3
Hydro & Geo	4.6	1.2	1.6	2.6
TOTAL	6.8	3.1	2.5	1.9

*Million Barrels/Day Oil Equivalent

U.S. Coal Supply

U.S. coal reserves are abundant, accounting for 90% of all known domestic fossil fuel resources. Annual coal production is projected to grow from 734 million tons in 1980 to nearly 1.3 billion tons in 1990 and to 2.2 billion tons in 2000. These figures include exports of coal, which rise from 47 million tons annually in 1980 to 143 million tons annually by 2000.

The largest user of coal is the electric utility industry, which is projected to account for three-fourths of domestic coal demand in 1980. While utility coal consumption is expected to increase over the Outlook period, its share of total domestic coal demand will decline to 45% by 2000.

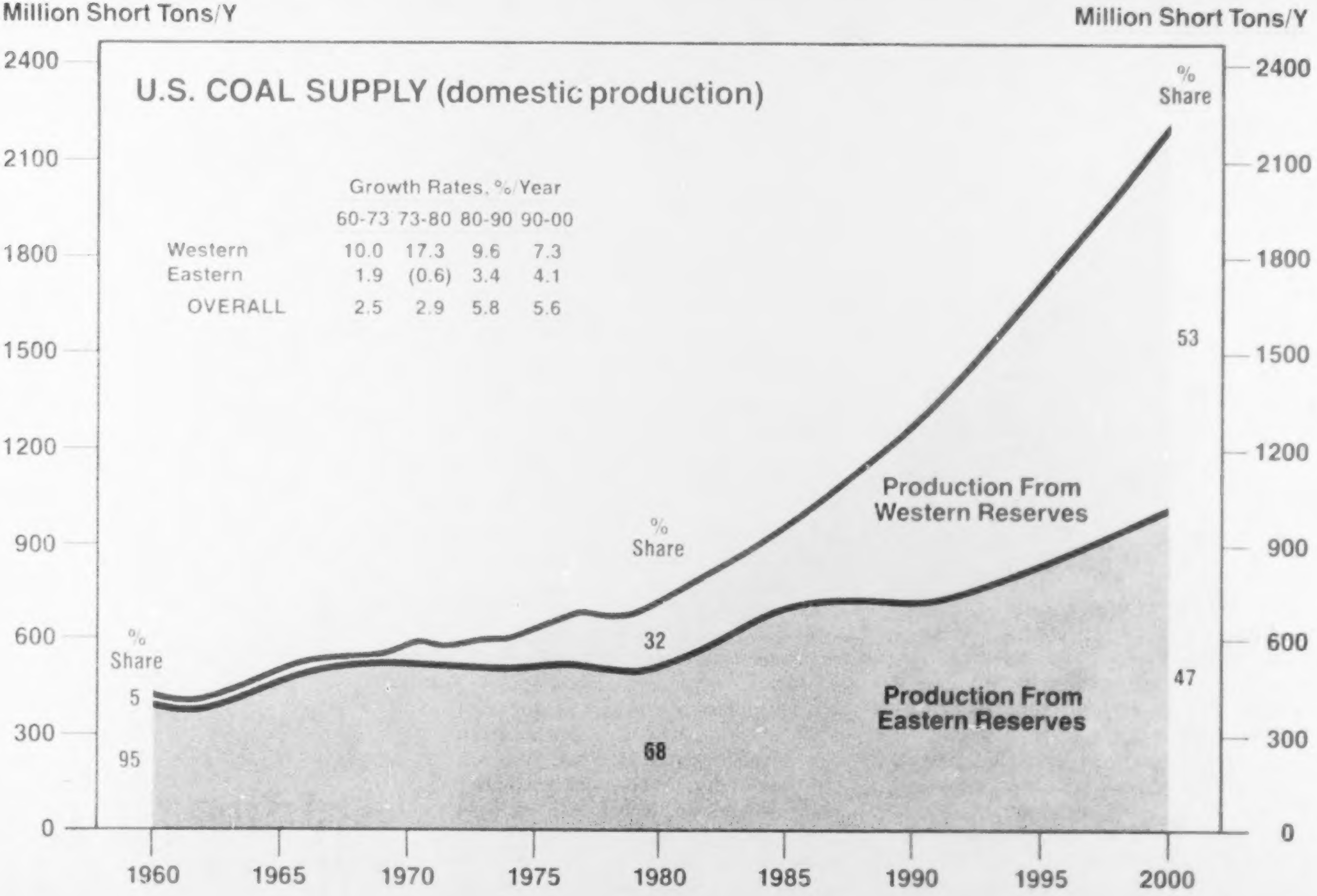
Eastern Coal Historically, coal fields east of the Mississippi River have provided the bulk of domestic output, but production from existing mines is declining. Most future production in this area must come from deeper, costlier mines. These higher costs will be offset by the fact that Eastern coal is close to established markets and is readily accessible to existing transportation systems. Eastern coal, which is high in sulfur content and BTUs, is expected to supply about 55% of U.S. coal production in 1990, and about 47% in 2000. This compares with 68% in the year 1980.

Western Coal Much of the growth in coal supply is projected to come from Western coal, which is lower in sulfur content — and BTUs — than Eastern coal, and is susceptible to surface mining. The contribution of Western coal to total production is expected to reach 45% in 1990 and 53% in 2000, compared with 32% in 1980.

Synthetic Fuels Gas and liquids produced from coal are expected to become commercially available in the mid- to late 1980s. By 1985, 6 million tons of coal, or 0.6% of total U.S. output, are forecast to be used in the manufacture of synthetic fuels; this rises to 160 million tons, 12% of output, in 1990, and 645 million tons, 30%, in the year 2000.

U.S. Coal Production
(million short tons/yr)

	1960	1980	1990	2000
Western	22	232	581	1,170
Eastern	412	502	704	1,049
TOTAL	434	734	1,285	2,219



U.S. COAL SUPPLY (domestic production)

Growth Rates, %/Year

	60-73	73-80	80-90	90-00
Western	10.0	17.3	9.6	7.3
Eastern	1.9	(0.6)	3.4	4.1
OVERALL	2.5	2.9	5.8	5.6

U.S. Gas Supply

U.S. natural gas production has been declining since 1973, when it peaked at 22 trillion cubic feet (tcf) per year. This decline is expected to continue; by the year 2000, production is expected to drop to only 11.3 tcf per year, about half the 1973 level.

Gas production on Alaska's North Slope is expected to start in the mid-1980s and will provide about 5% of total U.S. production in the latter half of the 1980s. More than 35% of U.S. natural gas production in 1990, and nearly half of that in 2000, must come from reserves yet to be discovered. The lower 48 states, both inland and offshore, will continue to play a key role in future gas discoveries.

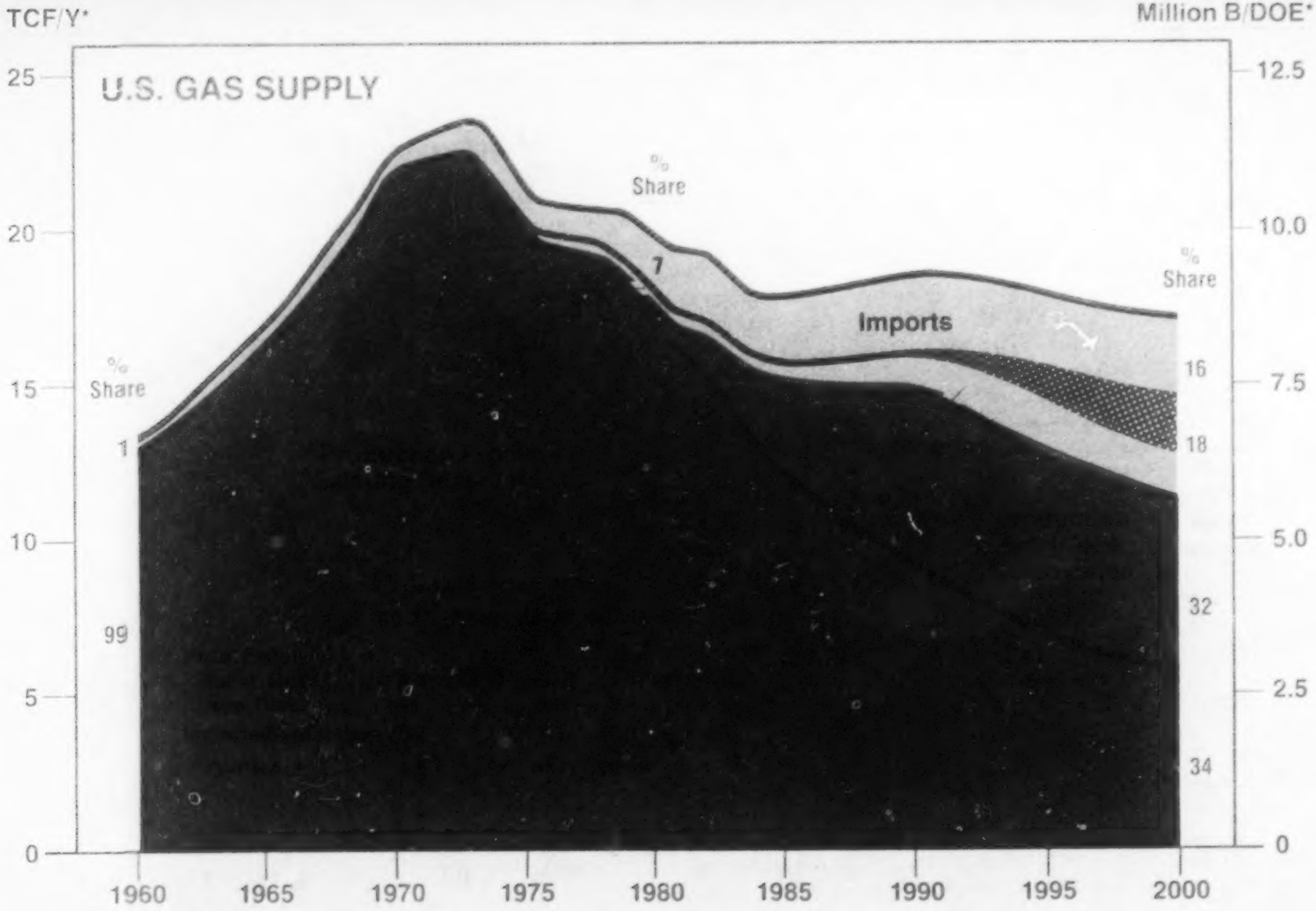
Rapid exploration of the petroleum resource potential of the Outer Continental Shelf (OCS) is essential if the decline in natural gas production is to be offset. The rate of OCS production growth will be determined largely by governmental leasing and regulatory policies.

Synthetic Gas About 0.4 tcf of gas per year are currently produced by reforming from naphtha and liquefied petroleum gas. Synthetic gas from coal is projected to be commercially available beginning in the mid-80s. Total annual synthetic gas production could range between 0.6 and 1.0 tcf by 1990. By 2000, the outlook is for synthetic gas production to reach a level of 2.0 to 3.1 tcf, or between 12% and 18% of total supply. However, as indicated by the shaded area on the chart, if synthetic gas production does not achieve these higher levels, additional imports would be required.

Imports Gas imports are projected to increase from 1.4 tcf in 1980 to 2.6 tcf in 1990, and to 2.8 tcf by 2000. Overland imports from Canada and Mexico are expected to supply about 70% of the gas imports throughout the period while imports of liquefied natural gas (LNG) are projected to account for the remaining 30% of gas imports.

U.S. Gas Supply
(trillion cubic feet/yr)

	1960	1980	1990	2000
Domestic				
Conventional	12.8	18.2	15.1	11.3
Synthetics	-	0.4	1.0	3.1
Imports	0.2	1.4	2.6	2.8
TOTAL	13.0	20.0	18.7	17.2



*2 Trillion Cubic Feet of Gas/Year = 1 Million Barrels/Day Oil Equivalent

U.S. Oil Supply

U.S. Oil Supply
(million barrels/day)

	1960	1980	1990	2000
Domestic				
Conventional	8.1	9.9	6.1	6.3
Synthetics	-	-	1.0	4.6
Imports	1.8	8.1	9.3	5.5
TOTAL	9.9	18.0	16.4	16.4

Domestic oil production peaked in the early 1970s and is declining. The decline has been slowed, however, by the advent of North Slope oil, which began flowing through the trans-Alaska pipeline in 1977. North Slope production rose to 1.5 million barrels per day in late 1979. Further discoveries will be required not only to increase North Slope production, but also to sustain production rates over the long term.

Conventional domestic oil supply declines from a little more than 10 million barrels per day in 1978 to about 6 million barrels per day in 1990. By the year 2000, about 65% of conventional domestic supply must come from reserves yet to be found.

Recent exploratory results in such areas as the Gulf of Alaska and the Baltimore Canyon off the New Jersey coast have not been encouraging. Nevertheless, most large new domestic discoveries are still likely to be in Alaska and the Outer Continental Shelf.

Lead times between initial exploration and first production in some areas are estimated to be 8 to 11 years. Accordingly, rapid exploration and development of the petroleum resource potential of the OCS is essential to help offset declining onshore oil production. The rate of OCS production growth will depend on governmental leasing and regulatory policies.

Synthetic Oil Shale oil and coal liquids will become commercially available by the mid-80s with production amounting to between 0.7 and 1.0 million barrels per day in 1990. In the year 2000, synthetics could comprise about 20% to 30% of U.S. oil supply. However, if development of synthetic oil production does not achieve the higher projections, additional imports would be required. This is shown by the shaded area on the chart.

Imports Oil imports are projected to increase from the 1978 level of 8.2 million barrels per day, about 44% of total supply, to about 9.3 million barrels per day in 1990, or about 57% of total supply in that year. By 2000, oil imports will decline to 5.5 million barrels per day, 33% of that year's supply. The bulk of these imports will continue to be supplied by members of the Organization of Petroleum Exporting Countries.

The availability and price of these imports will depend on the policies of producing country governments, particularly in the Middle East, where a major share of OPEC's remaining reserves is located.

The Role of Synthetic Fuels in the United States Energy Future

Synthetic Fuels: A Critical National Need

Exxon's continuing analysis of energy trends, conducted in the regular course of business planning, has led to a growing conviction that rapid development of a synthetic fuels industry in the United States is a critical national need.

- A synthetic fuels industry can start contributing to domestic energy supply by the end of the 1980s, and can grow to a large sustainable volume in the '90s. Several processes for making synthetic fuels are in advanced stages of development and are ready for application in commercial-sized plants.
- Such processes can apply the country's greatest energy strength to its most pressing energy need, by converting abundant domestic resources — oil shale and coal — into liquid and gaseous forms for uses now served by oil and natural gas.
- Timely development of a synthetic fuels industry is essential to any realistic expectation that the country's need for imported petroleum can diminish substantially in this century.
- This development is critically important to national security and to standards of living in the future.
- The synthetic fuels industry can represent a substantial strengthening of the country's industrial base. Its growth potential offers some of the most significant business and employment opportunities in modern history.
- But development on a timetable consistent with national security and economic needs will require cooperation, of a degree that may be unprecedented in peacetime, among business, labor, government at all levels, and other interest groups.

The public understanding requisite for such cooperation does not exist today. This report, intended to contribute to the needed awareness, presents Exxon's assessment of the opportunities available to the United States for meeting future energy needs — with emphasis on the role of synthetic fuels. Data, projections and illustrations are drawn from a U.S. energy outlook and other studies that are developed by Exxon and regularly revised in the light of events, as a basis for internal planning, corporate strategy and investment decisions.

An Energy Transition Already Begun

A domestic synthetic fuels industry has a potentially important role but cannot provide a total solution to America's energy problems. It will not eliminate needs for aggressive efforts in development of other forms of energy and in energy conservation. It should be viewed in a realistic context — as one of several tools essential to successful management of an inevitable energy transition that already has begun and will continue for generations.

The U. S. and world economies are shifting from dependence on energy provided principally by oil and gas to a more diversified mix of supplies. The transition will likely lead, during the 21st Century, to substantial reliance on energy from renewable and nondepleting sources.

For the United States, the need for a transition to other energy sources began to develop when the country started producing oil and natural gas faster than new reserves could be discovered. Domestic petroleum production is declining, and Americans have become dependent on foreign countries for almost half of the oil they use. The rest of the free world is now following the pattern — using more petroleum than is being found. Production in some of the Middle Eastern countries with the world's largest oil reserves eventually will plateau and decline — perhaps in the early part of the 21st Century.

The transition to non-petroleum forms of energy will continue for decades, but some of the difficulties involved are already apparent.

U. S. consumers have experienced temporary shortages of oil products on several occasions — including those resulting from the embargo of 1973-74 and the revolution in Iran in late 1978. The balance of world oil supply and demand remains precarious. And for years to come, the risk of shortfalls is likely to be greater than the prospect of surpluses.

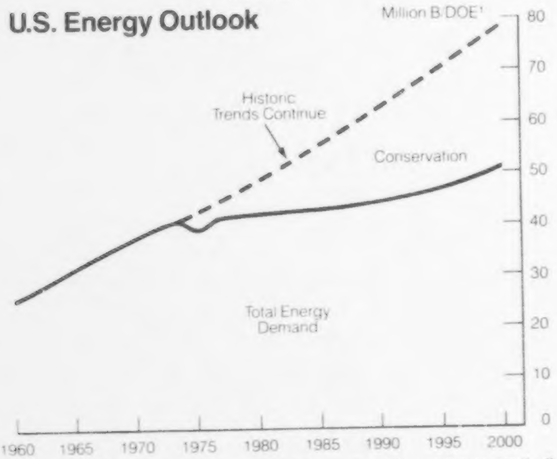
The rising price of oil imports, and the country's increasing dependence on them, have contributed to trade-balance problems, inflation, declining real personal discretionary income for individuals, and other economic difficulties. An end to the trend of rising real costs of energy is not in sight.

A crucial question is whether the nation will continue to "muddle along," or will begin to successfully *manage* its way through the transition — seizing its feasible economic opportunities to save energy and to develop additional domestic energy supply. Unless this happens, succeeding generations of Americans face the prospect of real decline in economic well-being, reduced opportunities for employment and advancement, and further loss of independence in international affairs.

There are numerous opportunities to improve the domestic energy balance. But they are not, generally speaking, alternatives to one another. Some can affect energy demand or supply almost immediately. Others can produce benefits within the next decade or two. Still others will have no significant impact until well into the 21st Century. Furthermore, not all forms of energy can substitute for the scarce fuels — conventional crude oil and natural gas — in all uses.

Failure to make distinctions concerning the time frames and the uses in which potential sources of energy can help

(Illustration I)



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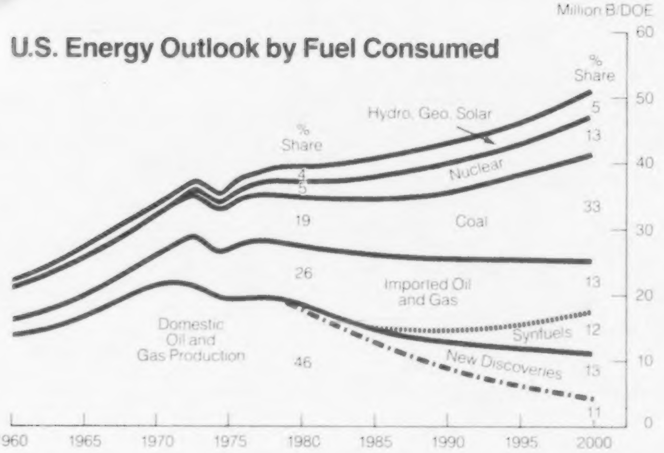
[1] B/DOE refers to barrels per day of oil equivalent. A barrel of oil equivalent is a common unit of measure, used to quantify all sources of energy on the basis of their heat content. It is equal to the energy obtainable from a barrel of crude oil.

(Illustration 2)



U.S. Energy Outlook by Fuel Consumed

could lead easily to planning based on wishful thinking — with potentially disastrous consequences for U.S. security and long-term economic health.

Energy Conservation

The most obvious, widely recognized opportunity to improve the domestic energy balance — and one that can have immediate impact on the level of petroleum imports — is energy conservation.

Because lead-times required to develop new energy supplies generally range between six and 12 years, near-term domestic supply is essentially fixed — leaving reduction of demand as the only short-term way to lower significantly the U.S. need for imported energy.

Consumers throughout the economy are responding to the rising costs of energy by finding ways to use it more efficiently — in homes and stores, in transportation, and in industry. In the operations of Exxon USA, for example, an intensive conservation effort is saving enough energy to meet the electricity needs of more than one million American homes.

Savings also are resulting from better new car gasoline mileage, lower highway speeds, thermostat adjustments and other actions mandated by government.

The combined effect of voluntary and mandatory improvements in efficiency is to hold energy consumption well below levels that would have been reached if price and use patterns had followed the trends experienced prior to the 1973-74 embargo.

U.S. energy demand this year (Illustration 1) is about 13 percent below the "trends-continue" level — reflecting a savings of six million B/DOE. Savings are projected to reach 27 percent, or 16 million B/DOE, by 1990 and 35 percent, or 27 million B/DOE, by 2000.

Improved efficiency also has altered the relationship between energy use and economic growth. During the 13-year period preceding the Arab oil embargo, it took a 4.1 percent average annual increase in energy consumption to support an identical 4.1 percent rate of growth in real Gross National Product. But it is projected that in the 1980s and '90s economic growth will average 2½ to 3 percent, while energy consumption grows at rates averaging only 1 to 1½ percent.

It would not be prudent, however, to rely solely on conservation as a solution to energy problems. Despite improving efficiency, some increase in energy consumption still must occur if the economy is to grow sufficiently to meet employment and income needs of a growing population.

At the projected 1 to 1½ percent average annual growth rate, U.S. energy demand in the year 2000 would be about 30 percent higher than it is today.

Sources of Energy Supply

America has substantial energy resources which potentially can help meet this demand. Eventually their development can enable the country to start reducing its need for foreign petroleum — although oil and gas imports are expected to continue to be significant at least through the mid or late 1980s.

Each feasible source of additional supply has its capabilities and limitations. Each can supply certain quantities of energy, in certain time frames, in forms suitable for certain uses. (Illustration 2)

Nondepleting and renewable sources are not expected to meet substantial portions of energy demand until well into the 21st Century. *Hydroelectric* and *geothermal* energy, for example, are limited by the availability of suitable sites.

Solar energy offers significant potential, but its growth is presently inhibited by high costs. Converting the sun's rays directly into heat with today's technology is typically three to four times as expensive as obtaining the heat from conventionally generated electricity. Technological breakthroughs eventually may bring costs down, and should be pursued vigorously. But it should be recognized that, even after the breakthroughs occur, it will take decades to apply the new technology widely enough to meet a significant share of energy demand.

Solar units for space and water heating are becoming more competitive in areas where electricity costs are high. The rate of deployment, however, is likely to be slow. Even if economics could be ignored and such units could be installed in *all* new homes, beginning today, more than 20 years would pass before the units could meet 1 percent of the country's energy needs. (This assumes that the units would provide one-half of the new homes' space and water heat. The other half would come from conventional back-up heating systems, which take over when sunlight is inadequate.)

Direct conversion of solar energy into electricity is even more expensive and farther away from economic feasibility.

Nuclear fusion ultimately may add dramatically to the already substantial potential of nuclear technology to provide electricity. But fusion is still in the research and development stage, and commercial demonstration is unlikely before the year 2000. Even after commerciality is demonstrated, fusion will not displace other sources overnight; it will be phased in as electricity demand grows and older plants become obsolete.

Small quantities of liquid fuel are now being provided by ethanol, an *alcohol* made from grain or other crops and then blended with gasoline to form gasohol. Costs of the ethanol are higher than those of foreign oil or of synthetic fuels that can be derived from oil shale or coal, but this fact is masked by tax exemptions and other subsidies. Alcohol does have some potential for contributing to domestic liquid fuels supply—provided producers turn from oil and natural gas to coal or biomass as sources of the energy they use in processing. U.S. and world food requirements place limitations, however, on acreage that can be used to grow alcohol feedstocks. And these limitations suggest that alcohols made from renewable crops can have only modest long-term impact on the energy transition in this country.

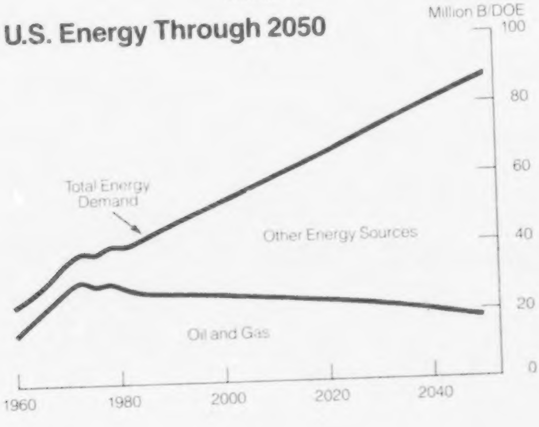
During the decade of the 1980s, virtually all growth in domestic energy supply will have to come from conventional nuclear power and from direct burning of coal.

Nuclear fission has been the nation's fastest growing source of energy. It now meets about 5 percent of energy demand, a share that could increase to 13 percent by the year 2000 if concerns about safety and other problems are satisfactorily resolved. Enough reactors are under construction or on order to meet this projection through the 1980s. But the ordering rate will have to increase soon, reversing the trend of the past few years, if projected growth through the 1990s is to be achieved.

Growth in the use of *coal* over the next few decades will be limited only by demand. Its conventional uses now account for about 19 percent of energy consumption, and this share is expected to increase to about 33 percent by 2000.

To achieve this growth—and to provide coal for feedstock in making synthetic fuels—mining production will have to increase from about 730 million short tons this year to almost 1.3 billion in 1990, and to more than 2.2 billion in the year 2000. Because coal reserves and the mining industry's expansion capabilities are more than adequate, this growth is a realistic, achievable objective.

(Illustration 3)



It should be emphasized, however, that nuclear power and coal have only limited usefulness in meeting some significant needs now served by *oil* and *natural gas*.

Nuclear provides energy only as electricity. And coal, with today's technology, substitutes for oil and gas only as boiler fuel for electric generators and other large industrial facilities. Conversions of boilers from petroleum fuels to coal often are very costly, and much of the economically feasible conversion already has occurred.

There are large segments of energy demand—particularly for transportation and petrochemical feedstocks—that can be met only by liquid and gaseous fuels. Current U.S. demand for such fuels, about 28 million B/DOE, is projected to decline only gradually—remaining above 25 million B/DOE through the rest of the 20th Century. These segments of demand will have to be served by domestic petroleum, imports and synthetic fuels.

Future discoveries of domestic oil and natural gas will be critically important. They are expected to account for about 30 percent of the domestic petroleum production of 1990, and over half the production projected for 2000. This dependence on new discoveries emphasizes the need for a continuing high level of exploration activity, and for leasing unexplored federal lands and offshore areas that may have geological promise. Every new barrel of oil or gas production the nation achieves will directly reduce its need for imported energy.

U.S. oil and gas production has been declining, however, since the early 1970s. Virtually all new reserves will be difficult and expensive to find and develop. Frontiers of exploration are moving into Arctic environments and deeper ocean waters. And, under the best of circumstances, major discoveries made in the next few years can come into full production no sooner than the late 1980s.

In light of these factors and the disappointing results of exploration over the past decade, it seems likely that new discoveries will continue to be less than production. The only realistic planning assumption is that domestic petroleum production will continue to decline.[2]

Even with substantial conservation efforts, this points to a continuing high level of *petroleum imports* through the 1980s, and to a continuing need for working relationships with oil-exporting nations. Governments in the producing countries understandably want to conserve their resources and are reluctant to meet new increases in demand.

Key Role of Synthetic Fuels

It may be possible, however, for the United States to significantly reduce its dependence on imports in the 1990's—provided planning and construction of *synthetic fuels* plants begin *now* and accelerate rapidly within the next few years. It is projected that these fuels' share of total U.S. energy demand can reach 12 percent by 2000 and will continue to increase in the 21st Century.

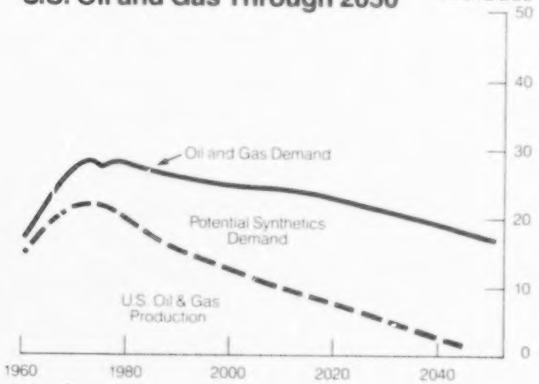
Demand for oil and gas is expected to decline gradually as substitution of other fuels, coupled with technological breakthroughs such as improvements in the electric automobile, allows non-petroleum sources of energy to meet an increasing share of total domestic energy needs. A substantial demand for liquid and gaseous hydrocarbons is expected to continue, however, well into the 21st Century. (Illustration 3)

Potential demand for synthetic fuels—the difference between projections of domestic petroleum demand and production—is likely to reach an estimated 15 million B/DOE early in the 21st Century. (Illustration 4).

Obviously these projections are subject to variation, but the essential point is that for decades to come there will be a large demand for energy in liquid and gaseous forms which

(Illustration 4)

U.S. Oil and Gas Through 2050



cannot be satisfied with domestic oil and natural gas. In meeting this demand, synthetic fuels are the alternative to continued reliance on imported petroleum through the 1990s and beyond.

If new domestic discoveries of oil and gas should turn out to be greater than expected, and if the nation also has moved rapidly to develop its synthetic fuels potential, the variance from projections would be beneficial — allowing faster progress in reducing the nation's dependence on imported petroleum.

On the other hand, exploration results may fall short of projections. If they do, and if progress in synthetic fuels development also is disappointing, the resulting increase in need for imports would be a problem of serious proportions. In view of the present precarious balance of world oil supply and demand and the future outlook, it is unlikely that the needed quantities of foreign petroleum would be available.

Among the potential supplements to domestic oil and gas supplies, synthetic liquids and gases made from oil shale and coal have potential, in contrast to the alcohol fuels made from grain, for build-up to large sustainable volumes. A number of processes for making fuels from coal and oil shale have seen successful commercial use in other countries. Others have been in research and development stages for years, and are approaching readiness for commercial application.

Shale oil now appears to be economically competitive with imported crude oil. It is obtained from oil shale — a finely textured sedimentary rock containing an organic substance called kerogen. The rock can be mined, with underground or surface techniques, then crushed and heated to yield an oil resembling heavy crude. After processing to remove impurities and lighten the oil, conventional refining methods can turn it into a variety of oil products — including gasoline, jet fuel, heating oil and fuel oil.

Several methods of processing oil shale in large *surface retorts* have been demonstrated in large pilot plants and appear ready for scaling up to commercial size. Efforts to find feasible ways of using *in-situ* techniques, which would process the shale underground, are continuing — although early attempts were generally unsuccessful.

An *intermediate BTU gas* (IBG) made from coal also appears to be economically competitive. IBG is a mixture of hydrogen, carbon monoxide, and methane. When burned it yields about 40 percent of the heat that could be produced by burning a like volume of natural gas. It is suitable for use as a fuel for large industrial facilities and as a valuable feedstock for petrochemical processes, but not for mixing into conventional natural gas transportation systems.

The heat content of IBG can be increased, by a process that converts the hydrogen and carbon monoxide into methane, to provide a *synthetic natural gas* (SNG). It is indistinguishable from — and could be mixed, transported and burned with — natural gas. This additional processing increases costs by some 15-25 percent, but SNG potentially can supplement gas supply for homeowners and specialized industrial uses now requiring natural gas.

The least costly method of obtaining *liquid fuels from coal* with today's technology appears to be an indirect process for producing *methanol*. The coal is first processed into IBG, which in turn is further processed to yield both methanol and SNG. The methanol can serve many traditional fuel and chemical uses. Its cost — with appropriate adjustments for differences in location and product qualities — is estimated at about 20-30 percent higher than shale oil, IBG, or imported crude oil. But this estimate is sensitive to the revenue the producer realizes from the sale of the co-produced SNG.

Much research and development work is being done on other technologies which convert coal, directly or indirectly, into other liquid fuels. Costs of these liquids are now estimated at 40-60 percent above IBG, shale oil or imported crude oil but technological advancements are likely to bring costs down. These processes will be needed to allow efficient utilization of a wider range of coals, but are not yet ready for commercial application.

Much synthetic fuels technology, however, is now ready for commercial use. And the domestic resource base is adequate to support a very large industry.

Resources and Investment Needs

Known recoverable reserves of coal and oil shale — even after deducting coal to be used conventionally and the energy to be consumed in processing — are capable of providing synthetic fuels equivalent to one trillion barrels of oil. That's three times as much energy as the U.S. Geological Survey estimates can be provided by the country's remaining proved and undiscovered reserves of oil and gas. And it's enough to sustain a synthetic fuels industry producing 15 million B/DOE for 175 years.

The investment required to attain production of 15 million B/DOE is staggering — almost $800 billion in 1980 dollars (over 3 trillion "as spent" dollars). This would be spread over 30 years or more, however, and is within the capabilities of private companies.

In peak years, it would represent about 1 percent of GNP — roughly what is now expended for conventional domestic exploration and production of oil and gas. To put it another way, these capital expenditures would constitute about one-tenth of private, nonresidential investment.

A Massive But Manageable Task

Considering the readiness of technology, size of the resource base, and financial capabilities of the private sector, a goal of meeting the potential synthetic fuels demand of 15 million B/DOE by the end of the first decade of the 21st Century would be highly ambitious — but not beyond achievement by a determined America.

If the synthetic fuels industry develops at such a speed, it will be possible to begin reducing national dependence on petroleum imports within a decade, reduce them significantly during the 1990s, eliminate them early in the next century (if their elimination still appears desirable) and assure adequate supplies of liquid fuel and gas despite an anticipated decline in world oil production.

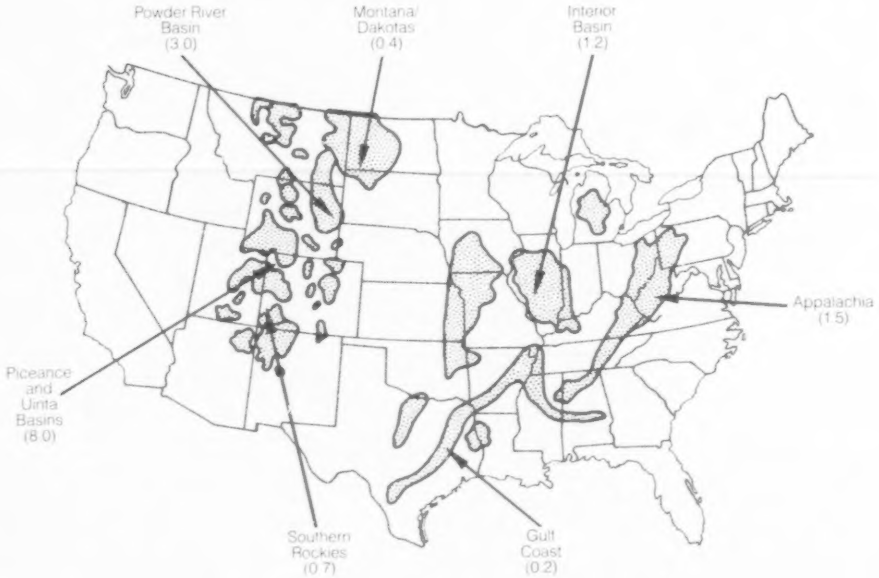
The task will be massive, however, by any standard of comparison. And it will be complicated by the fact that much of the industry will have to be concentrated in arid, sparsely populated parts of the West.

The output of a cost-effective 15 million B/DOE industry (Illustration 5) would include some eight million B/D of shale oil from high-yielding deposits in the Piceance and Uinta Basins in Colorado and Utah. About one-fourth of the shale

(Illustration 5)

Assumed Distribution Of Synthetics Industry

(Million B/DOE)


Powder River Basin (3.0)
Montana/Dakotas (0.4)
Interior Basin (1.2)
Appalachia (1.5)
Piceance and Uinta Basins (8.0)
Southern Rockies (0.7)
Gulf Coast (0.2)

Shale		Coal	
Surface Mines	6.0	Powder River Basin	3.0
Underground Mines	2.0	Other Western	1.1
		Eastern/Gulf	2.9
Total (Piceance & Uinta Basins)	8.0	Total Coal	7.0
		Total Synthetics	15.0

could be mined underground, but achieving the projected volume would require that the rest be obtained by large-scale surface mining. (Surface mining can recover up to 10 times as much shale as underground room-and-pillar methods.)

The remaining seven million B/DOE of synthetic fuels would be derived from coal—three million from the Powder River Basin of Wyoming and Montana, and another four million from other parts of Montana, the Dakotas, the Southern Rockies, the Interior Basin (Illinois and parts of adjacent states), Gulf Coast areas, and Appalachia.

Water Needs

Shale oil and coal synthetics require from two to four barrels of water for each barrel of product. And water supply is a major concern in dry Western regions where much of the development would occur.

Unless additional water is transported into these regions, it is unlikely that the industry's production can exceed seven million B/DOE—less than half the potential demand.

It appears financially and physically feasible to bring the additional needed water to the Piceance and Powder River Basins from the Missouri and several other Western rivers—at a resulting increase in costs of about 1 percent. As a side benefit, the transportation systems also could provide water for agricultural, municipal and other uses.

Employment and Population Effects

A synthetic fuels industry capable of producing 15 million B/DOE in the year 2010 would employ an estimated 870,000 people—480,000 in mining and 390,000 in the synthetic fuels processing plants. In peak development years, its growth would also provide 250,000 jobs in construction and 8,400 in design engineering.

Over the span of 30 years or more, the new industry would directly increase the nation's total number of jobs, over current levels, by 60 percent in mining, 55 percent in process industries, 15 percent in construction, and 35 percent in the applicable design engineering specialties.

These direct employment effects would be multiplied, of course, by the industry's demand for machinery and other products from suppliers, and by growth of new population centers in the development areas.

Careful planning will be required in these areas to develop, almost literally from scratch, transportation systems, housing, school systems, health care facilities, numerous public services and other essentials needed by thousands of workers and their families.

This will be a formidable challenge, but the task is manageable because the buildup will begin slowly and will be sustained over a long period. Nonetheless, the importance of timely advance planning cannot be overemphasized.

Summary and Conclusions

The need for rapid development of a synthetic fuels industry—to ease dependence on imported energy and to meet a coming shortfall of world oil supply—is clearly critical to the national interest. The resources are adequate. The technology is ready for commercial application. And the private sector has the necessary financial, technical and managerial resources.

There is no need for the federal government to assume the risk of a producer. But governments—at all levels—do have major roles to play.

The needed transfer of water, for example, cannot occur without governmental involvement and broad-based public support.

Coordination by industry and by governments at local and state levels will be essential in adequately planning for population influx and other impacts in the development areas.

Perhaps the greatest responsibility of the federal government, reinforced by state and local governments, is leadership—in building the public awareness of the critical national need to develop domestic synthetic fuels production as rapidly as possible and in creating the economic and regulatory climate to facilitate the new industry's growth.

A second major responsibility of the federal government is to function more effectively in a managerial role—reconciling conflicting priorities and regional interests, and assuring that studies, hearings and permitting processes proceed without inordinate delays of the sort that have slowed energy projects so often in the past.

Without bold, responsible, bipartisan political leadership, it is unlikely that the promise of synthetic fuels can ever be fully realized. And whether or not the industry's full potential is achieved will depend largely on how well industry, labor, civic leadership, environmentalists, and the governments of cities, counties, states and the nation can work together.

Vigorous effort must begin immediately if the national interest is to be served. Plans for the country's first synthetic fuels plants are now being made by several firms. But meeting critical national needs will require that work begin now on plans for continued development, beyond these initial plants, and even beyond the 1990 goals suggested by the President in the summer of 1979. What is needed is not just a few new plants, but an entire new industry.

The task is great. So is the need. And there is no time to lose.

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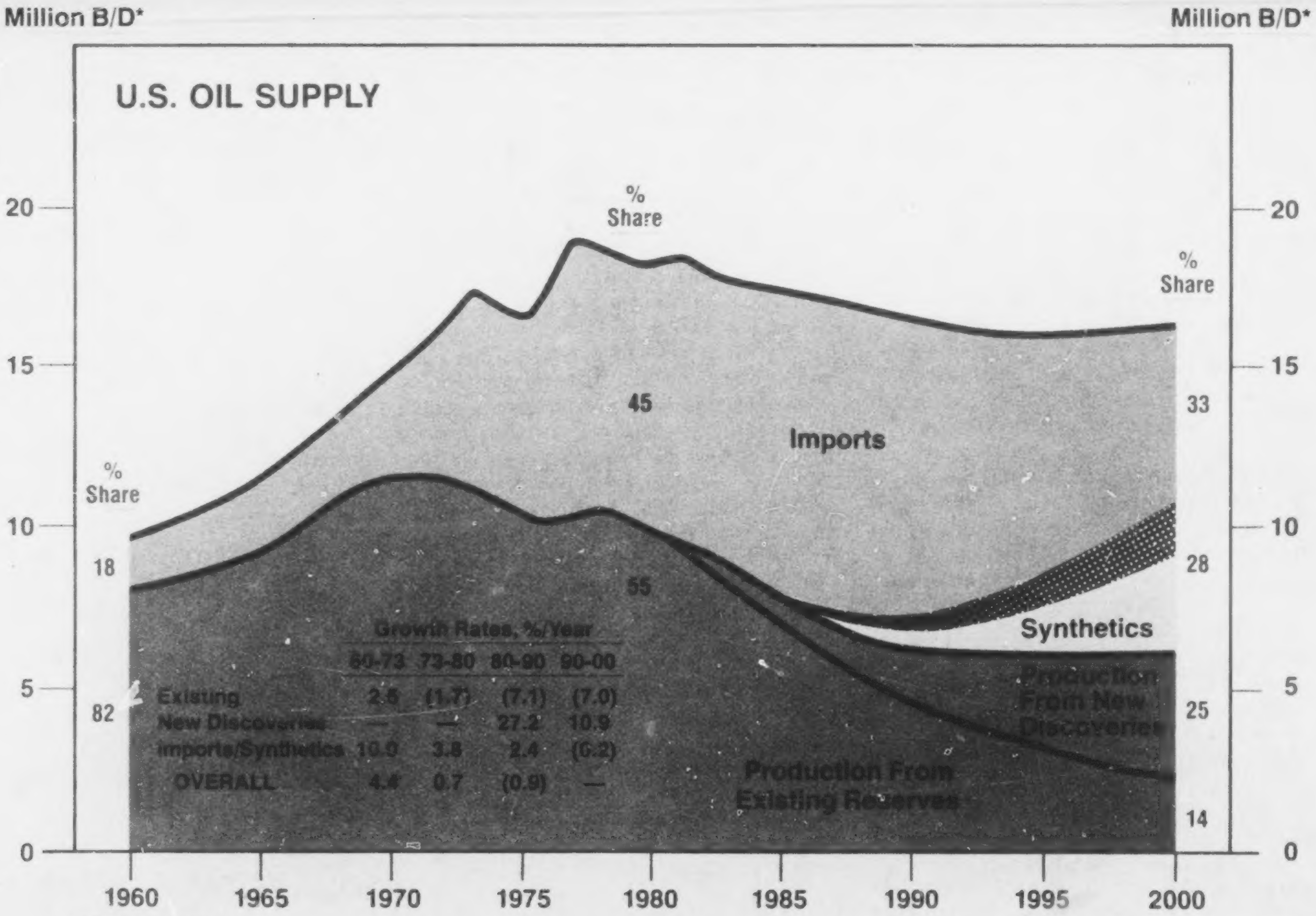

U.S. OIL SUPPLY

Growth Rates, %/Year	60-73	73-80	80-90	90-00
Existing	2.6	(1.7)	(7.1)	(7.0)
New Discoveries	—	—	27.2	10.9
Imports/Synthetics	10.0	3.8	2.4	(0.2)
OVERALL	4.4	0.7	(0.9)	—

*Million Barrels/Day

U.S. Energy Policy Implications

This U.S. Energy Outlook shows a continuing high level of oil use and an increased dependence on imports which peaks around 1990. It is customary to assume that oil imports will be available as needed, but this is not necessarily the case. For example, producing countries may perceive their objective to be better served by a slower and more sustained producing rate. Additionally, the Administration has proposed a program to limit oil imports to a level which is lower than needs projected in these studies. The domestic economic consequences of such a program could be severe: namely, higher unemployment, slower economic growth, and a stagnating national economy. We have therefore assumed that imports will not be limited by such a program.

Conventional oil production will not be sufficient to meet rising world demand indefinitely. The whole world, including the U.S., must eventually make a transition away from dependence on conventional oil and gas production to other energy sources that are more abundant and, ultimately, to nondepleting energy sources. During this transition from oil and gas there will continue to be a need for liquid and gaseous fuels for such uses as transportation, utility peak shaving, and feedstocks for the petrochemical industry. Converting the nation's abundant coal and oil shale reserves into these liquid and gaseous fuels will ease the transition to nondepleting energy sources and allow the U.S. the opportunity to reduce its reliance on imported oil while cost-effective technology for nondepleting fuels is being developed. Significant quantities of synthetic liquid and gaseous fuels will be required.

In Exxon planning studies, synthetic fuels volumes range from 4 to 6 million barrels a day oil equivalent in 2000. From a physical and resource point of view, the upper end of the range is feasible. However, to achieve this level of production will require a national resolve to aggressively develop synthetic fuels. Such a resolve does not yet clearly exist, and any projection of future synthetic production levels is subject to considerable variation.

The U.S. Energy Outlook presented here has considerable variability arising from uncertainties in economic growth, technological development, and exploration results. Moreover, it is significantly dependent on the policies adopted by the U.S. government. Achieving an appropriate balance between energy needs and environmental, aesthetic and safety concerns is required to permit the increased use of coal, nuclear and synthetics and to open undeveloped areas for petroleum exploration needed in the future. While striking this balance will be difficult, it should be done as objectively as possible and once achieved, regulatory procedures should be designed so as not to delay the implementation of projects which conform to the rules.

It is particularly important that efforts be made to develop all forms of domestic energy supplies and to use energy more wisely and efficiently.

There are difficult decisions to be made on energy development, both in this country and abroad. With informed choices, the transition to the new era of more widespread use of different energy forms can be made without drastic revisions in our economic system or in the ways we live and work.